UNITED STATES ARMY DECEMBER 1968

AVIATION DIGEST

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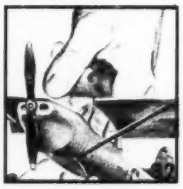

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ABOUT THE COVER

Burning candles ignite different thoughts, many relating to our country, our loved ones, our comrades in arms, our faith, our hopes, or perhaps personal memories. It is hoped this Christmas the candles on the cover will remind us of our freedom, in the same way English actor William Howard did when he said "the greatest glory of a free-born people is to transmit that freedom to their children." Our thanks to CW4 J. P. Ervin for the cover photograph of his daughter taken with a mirage lens.

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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★★ Its Developing Potential ★★

Army Aviation

Major General Willard Pearson
Director of Individual Training
Headquarters, Department of the Army

THE AIRMOBILITY Army aviation provides in Vietnam is the life blood of combat operations. In fact when the history of this war is written, it cannot help but be largely a history of Army aviation.

Looking at Vietnam, one finds Army aviation inextricably interwound into every facet of ground operations and deployed throughout the country — from the DMZ to the Delta and from the East China Sea to the Cambodian and Laotian borders. It provides mobility needed to move troops across rivers, over mountains, jungles and trackless wastelands.

Once the destination is reached, Army aviation's helicopters provide fire support, reinforcement, resupply, evacuation, command and control, communications and intelligence information.

Indeed, Army aviation provides the ground commander with many advantages. One results from a decision made about 15 years ago to integrate Army aviators into combat and combat support units, but at the same time have them retain branch qualifications. This policy is still in effect and provides commissioned pilots familiar with both ground and aerial operations.

Army aviators with branch experience are better able to respond to routine or emergency requests of ground commanders. However, one of the Army aviator's most important assets is that he is imbued with an immense team spirit to get the job done. He identifies with the ground forces he is supporting and, through experience, knows the problems confronting them.

Tactically speaking, close air support provided by sister services has been supplemented with outstanding results by the "guns" of Army helicopters. Many a combat commander in Vietnam would agree that Army aviation is his right arm in combat and the principal means of achieving victory.

The sophisticated helicopters in the Army inventory have added a new method of outflanking the enemy. Military leaders throughout history have attempted to do this through a variety of means: There have been countless forced marches. Hannibal attempted such a tactic with elephants; during the War Between the States there were great cavalry sweeps; and, in more recent times, we have seen these tactics used with tanks and airborne troops.

Today the helicopter offers the ground commander a new dimension — the vertical envelopment of the enemy's flanks or rear, a tactic which forces him into the undesirable situation of having to fight in two directions at once.

Army aviation also must be considered as the newest member of the combat team, which traditionally has been limited to Infantry, Artillery, Armor and Engineers. The skill, courage and spirit of team work demonstrated by aviation has elicited the admiration and respect of the other members of the combat team.

General Creighton W. Abrams, American Commander in Vietnam, during the battle of Huế in February 1968, recognized Army aviation as a member of this elite team. He pointed out that Army aviation did not become a member by invitation, fiat or directive. It earned the badge and then was accepted.

Beyond Vietnam, in limited, conventional or even nuclear war, Army aviation will be playing an equally vital role. Tactics will change and aircraft will be modified, but with its improving doctrine Army aviation can be effectively brought to bear on the battlefield of the future.

As the newest member of the combat team, aviation should feel free to innovate and experiment with new ideas for counterinsurgency doctrine. Some areas in which this should be concentrated include gunship support, organization and distribution of aircraft, improved maintenance and better weaponry. Army aviation is the most expensive member of the combat team and improvements in these areas would provide a greater payoff for the dollars invested. In addition, Army aviation can improve its net return through safer operation. More crew members and aircraft are lost in Vietnam from accidents than from hostile fire.

Every aviator who dons his wings also receives a heritage earned by the courage, valor and skill of Army aviators through three wars. The wings carry the admiration, respect and affection these men have earned. The ground soldier has learned to expect a great deal of Army aviation which must, and will, live up to the high standards of their predecessors.

New Eyes for the

Bad News Butterfly

The XM-58 antioscillation sight greatly increases the effectiveness of an already potent weapon system — the M-22

CW3 Clarence J. Carter

THE RECENT addition of the XM-58 antioscillation sight for the M-22 wire guided missile system gives the Army an added potential in helicopter mounted point target weapons systems. This combination makes it possible to engage and destroy a target at ranges up to approximately 2.2 miles.

This method of target engagement has been employed in recent M-22 gunnery qualification classes and has increased the hit averages. In one class, a student hit 10 for 10 while two others scored 8 for 10. These hits were sure kills, as the SS-11B missile is a point target weapon.

The SS-11B is a wire guided, two stage missile. It is approximately 4 feet long, weighs 64 pounds and has a 15 to 16.5 pound shaped charge warhead. The warhead will penetrate up to 24 inches of armor plate at 90° impact and 19 inches at 60° impact. The M-22 may be employed at ranges from 500 to 3,500 meters and may be fired while on the ground or at altitudes up to 5,000 feet and at any forward speed up to 300 mph. The missile attains a maximum speed of about 425 mph and has a disastrous effect on buildings and bunkers.

The XM-58 sight and its components will fit any of the UH-1B helicopters from 1962 and all UH-1C models. The mount consists of brackets and related reinforcements to provide secure, hard point mounting for the sight assembly ground above and forward of the operator's (copilot) position in the helicopter. The sight assembly group consists of the sight assembly (a two-axis gimbal system for the telescope and ring sight, adjustable headrest assembly, transmitting synchro) viewing devices, rate stick assembly, control box, and the line of sight indicator transmitter. All controls necessary for operation of the antioscillation sighting system (directional control, ON switch, POWER switch, two drift compensator (trim), and the synchro CAGE switch), are located conveniently to the sight assembly. The output of the transmitting synchro geared to the azimuth (yaw) gimbal provides an indication of target location with respect to the longitudinal axis of the subsystem weaponry on the line of sight indicator located on the panel in front of the pilot. Thus, the pilot is provided an azimuth indication of the target and visually indicates when the horizontal travel limits of the sight are about to be exceeded.

Attached to the bottom of the mount is the balanced azimuth gimbal, its housing, support arm and counterweight, and the mechanical stops which limit the horizontal travel to 45° either side of the helicopter center line. The elevation gimbal is fixed to a yoke on the azimuth gimbal support arm. Mounted on the elevation gimbal is the 6-power, 10.5-degree wide angle field of view telescope (monocular), polaroid ring sight and two motion sensing gyroscopes. The elevation gimbal incorporates mechanical stops to limit vertical travel of the telescope to 15° up and down from the helicopter center line.

Operating independently, the two gyroscopes sense helicopter motion electrically, then send signals to the control amplifier located on the floor of the helicopter just aft of the M-22 guidance control unit. The amplifier then sends counteracting commands to the gimbal motors, which move the sight in direct motion opposite to that of the helicopter. The sight, once set on a target, will stay on target during helicopter motion if the helicopter does not exceed the azimuth limits (45° left or right) or the

An Army UH-1 fires a wire-guided missile

elevation limits (15° up or down).

Also attached to the mount is the gimbal position control. This control is a horizontally mounted hand grip with a 360° button switch that allows the gunner to control and reposition the sight in any direction at rates up to 20° per second, depending on the amount of pressure applied to the 360° switch. With this control, the gunner is able to track moving targets with the sight stabilized. He can also use the 6 power magnification of the sight to scan the terrain for targets without being exposed to ground fire.

Once the target has been acquired in the telescope field of view, the antioscillation sighting system will maintain this line of sight without blurring, which is almost impossible to prevent when the optical aid is hand held or mounted to the aircraft. To get an idea of what the 6 power magnification means to the gunner, make a 1-inch cross on a piece of paper and beside it make a 6-inch cross. As you can see, there is quite a difference and this advantage greatly enhances the effectiveness of this system.

The SS-11 missile is guided by two wires that pay out from bobbins built into the missile, in much the same manner as line from a closed face spinning reel. These wires remain connected to the launcher until missile impact. They are connected to the guidewire terminals on the launcher which relays signals to the missile from the missile selector switch, missile selector box and the guidance control unit (GCU). The GCU transmits signals received and activated by the control stick operated by the gunner to control the missile in much the same manner as a radio control model airplane.

When firing at ranges of 1 to 2 miles, with the missile moving at speeds of 300 to 425 mph, the effect of controls movements are hard to determine, so here is another advantage of magnification. The

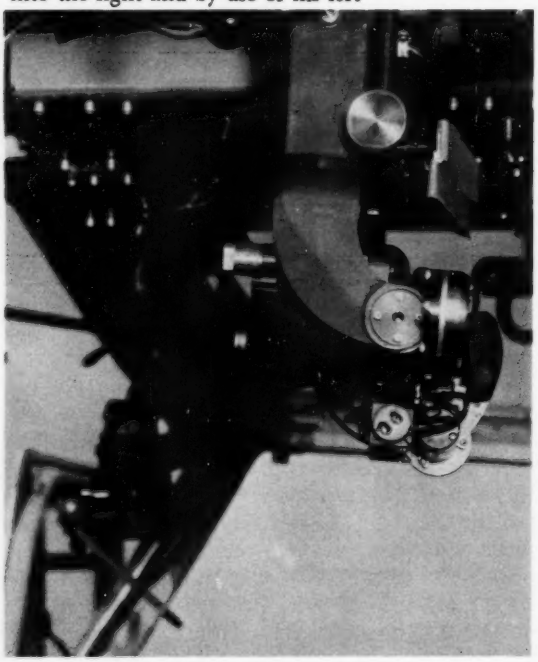
Bad News Butterfly

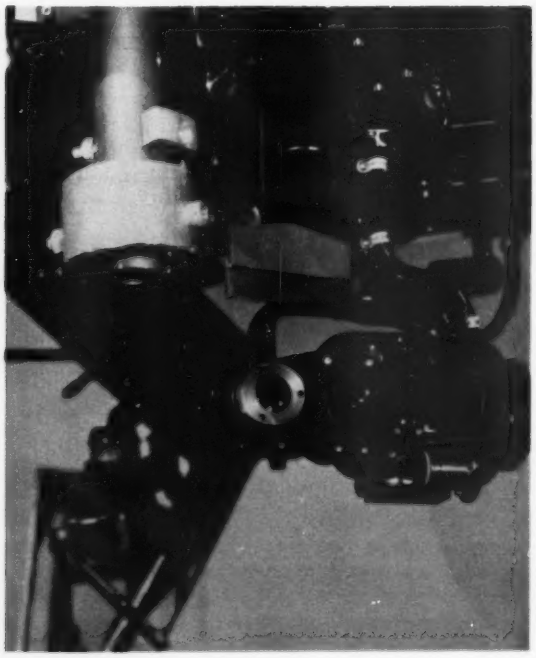
enlargement of the target also allows the gunner to pick the exact spot on the target he wishes to hit, and the average gunner can hit a 3-foot circle at 2 miles with the aid of the sight.

In making a normal firing run with this system, the M-22 ship would start its run at 3,000 to 5,000 feet above the terrain and about 3 to 5 miles from the target. The aircraft locks on the sight and when it closes to within 3,500 meters, the pilot starts a slight dive to allow the gunner to launch the missile toward the target. When this is accomplished, the pilot may then level the aircraft, climb, or take evasive action as long as he remains within travel limits of the sight. This method would be used if the airspace around the target area was secure.

The gunner launches the missile while looking around the sight which he has already stabilized in line with the target. He then looks into the sight and by use of his left

Above: an aviator test firing the M-22 missile system. Below: close up views of the sight being used by the aviator above





eye adjusts the flight of the missile so it is centered in the polaroid ring sight. The polaroid ring sight is adjustable to parallel the telescope and also has a matching field of view. The gunner then opens his right eye and guides the missile to the target.

At ranges of less than 1 mile, when the gunner has a clear view of the target, he may elect to fire without the sight. In this case, it is placed in the stowed position. Another advantage of the XM-58 is that the gunner is able to determine the damage done to the target while remaining out of the range of small arms fire.

Some of the other methods of employment of the M-22 system are the destruction of road blocks, strongly fortified bunkers, and buildings that may be defended by weapons with more range than the missile but are located where bombing or use of artillery is impractical. In this case, the M-22 ship would remain at very low level to take maximum advantage of the terrain until within range, and if required, hover behind whatever cover is available until firing is completed.

This technique must be employed over secure terrain. To minimize exposure time in this type attack, the gunner would acquire the target in the sight as far away from the target as possible. Then the pilot, taking care not to exceed the limits of the sight, would descend to nap of the earth and advance to the launch position. Flying time for the missile at 3,500 meters is 22 seconds, so aligning the sight early can cut exposure time greatly.

The SS-11 was designed primarily as an antitank weapon, but its destructive power, range, and flexibility make it a very desirable point target weapons system. It is one helicopter weapons system that can perform its mission and assess target damage while remaining outside the range of small arms fire up to .50 caliber.

Above: this view of an aviator firing the M-22 was taken from the back seat of the Huey. His right hand (obscured by the seat) uses the guidance system seen below to direct the missile inflight

The Fundamentals of

Armed Helicopter Flying

Captain Eugene Fudge

WHAT is a really good aviator? Probably the best answer would be the aviator who knows how to live in his environment.

In Vietnam, as in other areas of the world where the Army operates its aircraft, certain fundamentals should be followed. These fundamentals may differ somewhat for desert flying as compared to jungle flying, but basically they are the same. Some you learn when you first start flying; others you learn only after many hard hours in the cockpit.

One of the things you were taught in basic flying is to make

a high reconnaissance of an area before going in. High reconnaissance provides valuable information about the enemy situation and terrain which might go unnoticed at treetop level.

Only in rare cases is it necessary to proceed into an area at low level without making a high reconnaissance first. One reason would be if weather conditions had created a 300 to 400 foot ceiling. Then it would be wiser to go in at treetop level than to present a lucrative target at 300 feet.

The intelligence boys work real hard at gathering their information, but they can't always be right. When they say an area is free of the enemy this may be the one time they are wrong, so don't depend on it. Likewise, just because you have worked an area repeatedly without encountering resistance does not mean it will stay that way. The enemy can change his area of operation just as we do. Experience has shown that the majority of aircraft hits and casualties occur when the aircraft flies directly over an enemy position.

Once a target is identified while flying guns, a firing pass should be initiated at a distance within range of your weapons system. If the weapons are capable of killing at a range of 2,000 meters, then engage the target at that distance, situation permitting. The probability of your aircraft being hit increases the closer you get to the target.

Do not fly directly behind the lead helicopter (180° wing position). This will result in both ships having the same ground track. By flying in an extended right or left echelon, each ship has a separate ground track and will not overfly the same area. When two ships fly the same ground track, the first ship alerts the hostile forces on the ground to the presence of aircraft and increases the ground fire hazard to the second ship or wing ship.

Flying parallel to terrain features is dangerous because of the length of time your aircraft is exposed to enemy weapons systems usually employed along treelines, ridgelines, canal lines, etc. Also, flying parallel to terrain features establishes a pattern. When a pattern is established, the enemy's job is easier since he can predict your flight path. It is far better to avoid such terrain features as much as possible unless the mission dictates otherwise. When flights over and around linear terrain features are necessary, it should be at various angles to them. When conducting reconnaissance of a linear terrain feature you should use an S-type pattern.

Before becoming engaged in a given operation be certain you familiarize yourself with all available information pertinent to the intended operation. This must include the ground tactical plan, air plan, fire support plan, and any other plan that may be peculiar to the operation.

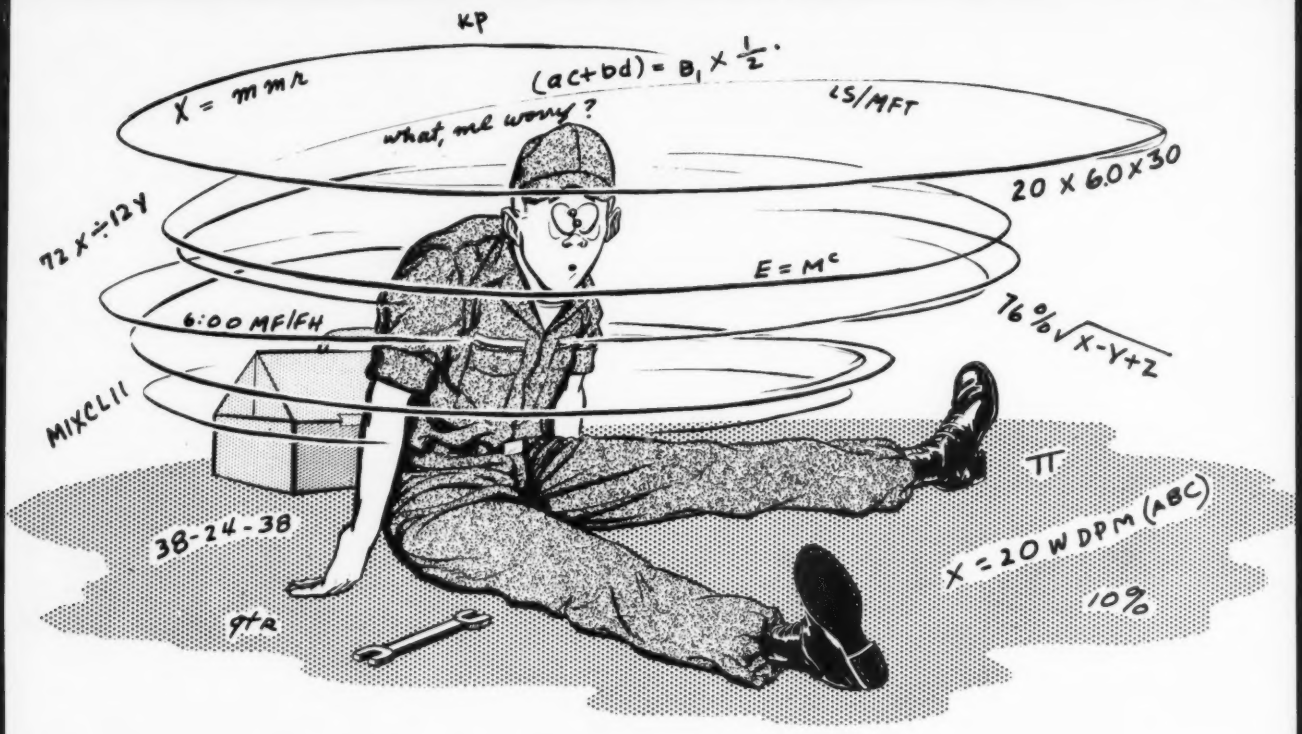
Everyone inside your helicopter is a very important member of your team and should be briefed before takeoff. When the mission is a rushed one, you may have to brief in the air. Often you will receive information which pertains to your mission over the radio from other aircraft in the area or forces on the ground. Make sure your elements monitor proper radio frequencies at all times. This will ease your control problem. As in any military operation, the five paragraph field order should be used.

Never fire until you have the friendly forces located. Identify the front lines, flanks, and adjoining units. Don't return hostile ground fire until the friendly troop dispositions have been positively identified.

Firing over the heads of friendly troops is usually the poorest attack direction for several reasons. The machinegun brass and links falling on the troops can cause a control problem for the ground commander. The falling brass, links, and the noise of the guns create the impression that you have misjudged the distance to the target and are firing into their position. Also by attacking over their heads, your flight path is straight into the enemy fields of fire aimed at the friendly troops. The enemy troop disposition is most likely to be parallel to the friendlies, and by attacking over their heads you will not take advantage of the weapons beaten zone. Attacks should be planned to make the long axis of the beaten zone of the weapons correspond to the long axis of the target.

Don't waste ordnance and don't expose yourself by engaging an unworthy target. If 50 percent will neutralize or suppress a target save the rest, because the enemy may have just begun to fight. Your mission is to support the ground commander to the best of your ability. At times you will be the only support available to a ground commander, so make each round count.

Shock action and surprise are two of the most important characteristics of all armed helicopter operations. This can only be accomplished by experienced and well trained crews without jeopardizing the safety of all concerned. While learning to live in the environment, remember to concentrate on accuracy and sound tactics; speed will follow.



What's All This PM Jazz?

It stands for preventive maintenance, but it could also stand for professional management

SFC R. Mullinax

THE U. S. ARMY uses a most workable and safety conscious aircraft maintenance system. The backbone of this system is PM (preventive maintenance). To fix the small things and inspect for incipient failures will continue to make a lot of sense because of improper maintenance until an airplane is developed that can be pulled over and parked when something breaks.

OK, you say, if it's such a great system then why doesn't it work? Well now that's a funny thing about a system, it just doesn't work unless you work it. Let's look at the picture from a simple viewpoint. What the system boils down to is a series of checks and rechecks based on, and scheduled according to, data obtained from previous experience. We'll call these organizational maintenance and inspections. Now, when we perform one of these operations we still come up with check and recheck in that the mechanics do the work, the inspector checks the work, and the supervisor checks on both and reports to the maintenance officer any problems encountered.

Now that sounds perfect doesn't it? With all these people checking on each other, what could possibly go wrong? Plenty of things can go wrong, but one of the main ones is a lack of understanding between maintenance and command, command and operations, operations and maintenance, or all three.

Let's look at this area and some of its problems. FM 101-20 states that (let's use the UH-1 series for an example) it takes an average of 5.5 hours of maintenance for each hour of time that a UH-1 helicopter flies. This of course doesn't mean that if we fly a ship today for one hour that we will find it necessary to perform 5.5 hours of maintenance tonight, but if we fly 100 hours this month, then the average maintenance time will be 5.5 hours x 100 flight hours.

This means the 550 manhours that should be accomplished for the 100 hours of flying should be broken down something like this:

• 300:00 hours for dailies,
• 90:00 hours for intermediates,
• 160:00 hours for periodic inspection.

Now if you have 25 UH-1 helicopters in a unit and each of these aircraft flies 100 hours in one month, then the minimum number of maintenance hours that will be required figures up to about 13,750 manhours. That's a pretty good sum of maintenance hours when you stop and look at it real close.

After your close look, are your maintenance personnel actually performing the maintenance required in the time designated? To aid you in determining these factors, the following formulas are submitted for arriving at proper conclusions:

- **To determine manhour workload where**
  - **x = minimum maintenance manhours required**
  - **n = number of type of aircraft involved**
  - **m = MH / FH ratio (manhour / flight hour)**
  - **p = average monthly flying hour factor**
  - **use formula x = nmp**
- **Example:**
  - **n = 20 UH-1 (hypothetical)**
  - **m = 6:0 MH/FH ratio**
  - **p = 30 monthly flying hour factor**
  - **x = nmp**
  - **x = 20 x 6.0 x 30**
  - **x = 3600.0 minimum manhours required per month (1st & 2nd echelon)**
- **To determine maintenance manhours available where**
  - **x = maintenance manhours available**
  - **a = number of direct maintenance personnel**
  - **b = hours per work day**
  - **c = number of work days in period (week, mo, qtr)**
  - **d = percent of time personnel are available excluding leave, KP, guard, illness, etc., based on local situation and specific period**
  - **use formula x = d (abc)**
- **Example:**
  - **a = 8 personnel**
  - **b = 8 hours per day**
  - **c = 20 work days per month**
  - **d = 76% time personnel are available for maintenance duty, therefore**
  - **x = d (abc)**
  - **x = 76% (8 x 8 x 20)**
  - **x = 973 available manhours per month**

In the sample problems, there was a deficiency of 627 manhours for the required maintenance. It may be to your advantage to run a check on your unit. It is important that commanders at all echelons understand that a certain percentage of EDPs is inevitable under present stockage policies. Experience indicates the EDP rate for most aircraft will be approximately 10 percent. This will vary depending on the newness and complexity of the major item and the distance of the unit from the source of supply.

Now how many times have you seen the operations officer or the commanding officer give the maintenance officer a hard time about availability of aircraft? One battalion in Vietnam demanded a 90 percent availability where applicable publications state that UH-1 availability should be 70 percent. If we stop and really consider the system, we'll find that the aviation maintenance program is developed to operate on a maximum TEAM effort to provide maximum availability of safe aircraft.

Yet, if commanders and operations officers do not take the time to understand and appreciate the maintenance officer's responsibility and efforts, then we are faced with an unworkable situation.

So let's work the system so the system can work for us. Using the inspection and checks referred to earlier, with the mechanics to do the work, the inspector to check the work, the supervisor to check on both and report to the maintenance officer, and most important perhaps the commander to assure that every link in the chain pulls under the same pressure smoothly and efficiently — then any unit can accomplish its mission satisfactorily and safely.

That PM jazz stands for preventive maintenance, but it also might stand for professional management.

The system can work for you, not against you

Airspray Techniques For Dust Control

The U. S. Army Engineer Waterways Experiment Station is testing a system that may alleviate a large part of the dust problem plaguing helicopters

A LANDING PAD suitable for helicopter operation has been prepared by using a helicopter airspray technique. Under a contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., Agricultural Aviation Engineering Company (AGAVENCO) has developed and flight tested the system. This aerial dispersal system designed for the UH-1B and D helicopter is capable of applying polyester resin and other dust alleviation material to unprepared ground surfaces.

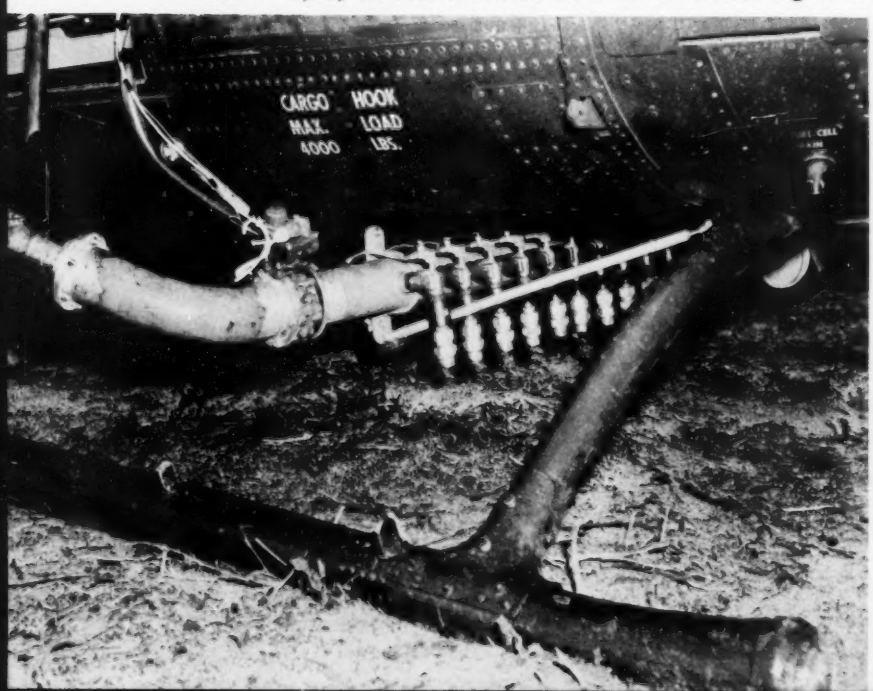
Responsibility for developing dust control materials and techniques in support of the Army in the field was assigned to the Waterways Experiment Station by the U. S. Army Materiel Command. The AGAVENCO system was based on specifications developed by the Waterways Experiment Station, who also designated the particular dust alleviating materials to be employed.

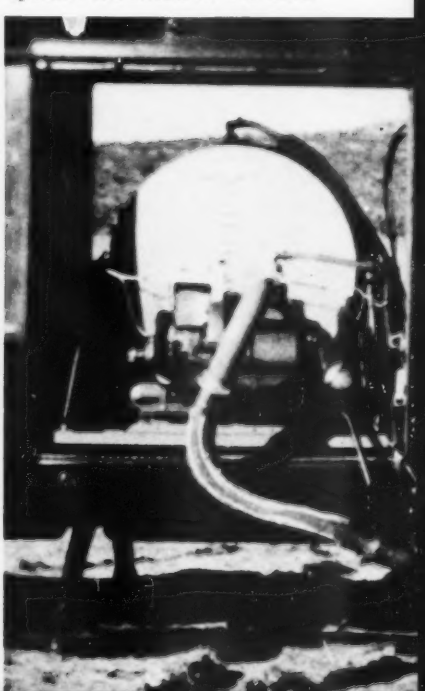
The objective of the concept is to quickly prepare a ground area upon which helicopters might land or ground vehicles may operate without creating a dust cloud. Dust is harmful to the helicopter and engine as well as being the direct cause of accidents due to loss of outside visual reference by the crew. The airspray technique, as compared with conventional and other experimental methods, makes it possible to rapidly and evenly distribute liquid dust control materials on ground surfaces without requiring ground personnel or other types of equipment.

After a design, development and laboratory test program by the contractor, the spray system was flight tested in a UH-1B helicopter at the U. S. Army Aviation Test Activity at Edwards Air Force Base, Calif. The equipment was quickly installed without any modification to the helicopter.

With the UH-1B flying at 15 mph and at approximately 7 feet in altitude, a 50′ x 50′ simulated helicopter landing pad was saturated with polyester resin in 10 adjacent and overlapping flight passes. Each pass sprayed down a sheet of liquid material 5 feet wide, as would be accomplished with a massively large paint gun. A latex base, water soluble dust suppressant material, 10 feet wide in two

Below: spray nozzles mounted on a UH-1. Lower right: the system mounted in the door





adjacent passes, was also applied around the perimeter of the polyester landing pad to demonstrate protective coverage of soil and vegetation.

The system was designed with a dual capability. During flight testing, polyester resin and catalyst were pumped independently and simultaneously through mixing nozzles to provide a quick hardening mixture. Also, the system sprayed and applied a single dust suppression material capable of self-hardening and drying upon exposure to air. During the final demonstrations, fluid flow patterns and control were applied within inches of a visually marked test grid, and distribution of both materials on the ground was consistent.

The dust control system incorporates an on-board gasoline engine pumping unit to achieve high rates of flow with materials of high viscosity and density. The entire system, in addition to being easily and rapidly installed and removed, is self-contained. It requires only nominal aircraft electrical power to activate control valves. Test photographs, movies, and landing pad samples verify that the airspray technique for landing site preparation is a feasible concept to accomplish the dust control mission.

AGAVENCO, in addition to dust suppression systems, has developed other military dispersal systems specifically for the Bell UH-1 helicopter. Among those developed are boom spray systems and rotary brush systems for defoliation and disease vector control, boom dust dispersal systems, and smoke generation systems for obscuration purposes. The company also is a major supplier of aerial dispersal systems and components for the commercial aerial application industry.

What'd Ja' Say?

CW4 C. R. Burroughs

READY TO ROLL her out for runup," the shop supervisor told the maintenance officer. The flight line crewmembers went through their daily checksheet. When refueling had completed the topping off, the line chief climbed in and fired up the Huey. Preliminary checks indicated good. The engine man and components men indicated no leaks. The flight line chief was watching the clock so he wouldn't go over his allowable run time. Normal shutdown and another check for leaks was next before tracking. "Really lucking out so far," the line chief reported, "if we don't have tracking problems."

"This was just another routine job," thought Joe Smedlock, the line chief. He'd been doing this about 10 years and was glad there weren't any problems. Seemed like the ringing in his ears didn't get too bad if he didn't have to spend too much time working with a "Bird." Joe didn't pay too much attention to the extra side tone noises in his ear until a few months back when his little girl held her new watch for him to listen to it tick. By golly he could see it was running but he couldn't hear it. Then during a trip to the beach Joe's wife had to remind him a couple of times that the turn signal blinker was still on and he hadn't heard the clicking. The two incidents convinced Joe to go to the flight surgeon for an audio check.

The news of nearly a 50 percent hearing loss really shocked Ole Joe. He used earplugs most of the time. Oh, he would jump in on a runup sometimes without the plugs, and tracked without them too. But what the heck difference could that make? He'd observed flight line personnel from other services with the ear defenders (muffs) on, but couldn't scrounge any. Now recalling what the flight surgeon had told him he probably would have saved his hearing if he had obtained the muffs through supply channels. Joe just didn't realize he

was losing the ability to hear sounds. But now he was becoming aware of little indicators such as having to ask someone to repeat a question; being accused of being snooty for not answering when he didn't hear a greeting; the car blinker; his little girl's watch; and a lot more.

Joe decided he'd ask his maintenance officer about getting some ear defenders and being refitted with earplugs for himself and his men also. He dug out some literature and learned some interesting things, like this decibel thing he'd heard about but didn't really understand.

The decibel (db) is a term borrowed from electrical communication engineering and represents a relative quantity. When it's used to express noise levels, a reference level is implied. Usually, this reference level is a sound pressure of 0.0002 Dyne per square centimeter and can be referred to as "0 decibels."

This starting point of the scale of noise levels is about the level of the weakest sound that can be heard by a person with very good hearing in an extremely quiet location. For example, the sound level in a large office usually is between 60 and 70 decibels. Now Joe could understand what a decibel measured.

The flight surgeon explained to Joe about how the noise exposure and hearing conservation program outlined in TB MED 250 (25 Jan 1965) was based on data gathered by taking noise measurements with a meter. It was possible to point to certain noise levels that indicate when it's advisable to initiate hearing conservation programs. If noise analysis reveals levels for various octave bands in excess of 85 to 92 decibels in the 150 to 9,600 CPS range, then ear protection must be used or there will be a loss of hearing.

Joe copied down the FSNs of the earplugs, containers for the plugs, and the ear muffs that the flight surgeon had in the TB that could be ordered through supply channels. He noted that the small, medium and large of one type plug only had one digit difference in the last four numbers, but the extra small and extra large had a different number. They are large 6515-299-8288, medium 8289, small 8290, extra small 6515-664-7858, extra large 7859. The case was 6515-299-8287. There was another type listed plus a cotton disposable type, but he was going to be able to get fitted by the flight surgeon any time he needed a new pair so he didn't worry about them.

Ordering ear muffs was going to be another matter. There were four types listed by different manufacturers, so he copied all of the numbers. They were 4240-861-3612 Aural Protector, Sound, High Performance, Noise Foe, Mark II, Mine Safety Appliances Co.; 4240-991-1910, same nomenclature, M258, Wilson Co.; 4240-226-6016, same nomenclature, M1200, American Optical Co.; and 4240-856-6650, same nomenclature, M19A, David Clak Co. Joe now knew that earplugs would help but they would only filter out about 20 percent of the noise. He could improve on this by using both plugs and muffs which together cut out 35 to 40 decibels.

Joe realized that it was too late to do anything to regain the hearing he lost. But, he reasoned that even though he had goofed, he could see to it that his men didn't. He could get them over to the flight dispensary for audiometer tests and fittings with plugs until the muffs were received. He could get an hour from the Ole Man's training and put the word out. He could point out to the troops that if they don't want to wind up like Ole Joe Smedlock, half deaf, they'd better start doing something now.

Are you a, "Huh, What'd Ja' Say"?

He could ensure that his men took ear tests

Tell Us A War Story, Mac

Army aviation could benefit from valid experiences, concepts and techniques developed by individuals and units in the field if they were reported through the proper chain of command. Also, a letter or note to the aviation school will get them to the proper agency for dissemination and incorporation into the training program

Major Robert E. Poston

THE INFANTRY company was in trouble. Intense fire from the fortified treeline to their front had them pinned down in the rice paddies and open area which they were attempting to cross. Now sporadic fire was beginning to come from both flanks as the enemy attempted to encircle the company position. What had begun as a fairly routine search and destroy operation was fast becoming a fight for survival in a cleverly set enemy trap.

It must have seemed to the company commander that everything that could possibly go wrong this day had already done so. Only moments before, when his company was not meeting resistance, he had requested that the supporting artillery battery be moved forward so that he would not move out of range of its supporting fires. Now, when he desperately needed fire support, the battery was enroute by helicopters to its new position. Although the move would be rapid, each minute could very well cost the lives of men in his company. He thought of tactical air support, but as he looked upward at the layers of low clouds above his position, he knew that the aircraft could not find nor support him under the 200 to 300 foot broken ceiling.

He reported his perilous situation to the battalion commander who advised that a platoon of aerial artillery had been dispatched to support the company while the

tube artillery was moving, and that the rocket armed helicopters should be nearing his position. Almost instantly, the radio operator reported that the platoon leader of the aerial artillery had checked into the company net. The helicopters were approximately seven kilometers south of the company position, but were encountering zero ceilings and patchy ground fog.

As the company commander glanced skyward to recheck the weather over his position, it seemed that fate had indeed chosen this day to plot against him. The ceiling was still a couple of hundred feet, but in places light fog and the ragged bottoms of clouds brushed the treetops, making it doubtful that the aerial artillery could pick its way through to his position.

Enemy fire from the flanks of the company position was increasing and mortar rounds were beginning to fall on his position. An assault or attempted withdrawal through the grazing fire from the fortified treeline would be disastrous under existing conditions. To stay put meant almost certain encirclement. He must have fire support on the fortified treeline and have it soon.

. . . how many lessons have been learned and new tactics, techniques and procedures developed never to be disseminated farther than to a few buddies at the bar?

In desperation the company commander grabbed the radio handset and called the platoon leader of the aerial artillery. He explained the urgency of his situation and his desperate need for artillery support.

The aerial artillery platoon leader already had given much thought to the possibility of such situations occurring. He had discussed it at length with the pilots in his platoon and decided upon various courses of action which he might take depending on the problem. Now without hesitation or delay he proceeded to implement one of the plans.

The leader climbed the platoon, in trail formation, above the lower layer of clouds and proceeded VFR between layers toward the beleaguered company's position. He queried the company commander about the approximate ceiling and visibility at his position, the magnetic azimuth and distance from the position of his radio set to the treeline to be attacked, a brief verbal description of the treeline and its orientation to the surrounding terrain, and that the company be prepared immediately upon command to mark the treeline with red smoke from rifle grenades.

As the platoon homed to the company's FM radio, the platoon leader made a careful map study of the terrain, elevations and obstacles around the coordinates given as the company's position. He then gave his platoon the following briefing on VHF: "Begin spacing yourselves in trail formation with one minute intervals between aircraft. The heading from the radio to the target treeline is 310° and the distance is approximately 400 meters.

"You heard the commander's description of the target. The elevation of the ground down there is approximately 100 feet with none in the immediate area higher than 150 feet and no known obstacles other than trees. The ceiling is apparently between 200 and 300 feet so we should break out with no problem. It looks like we will be able to maintain VFR on top or between layers at 1,200 feet until reaching the company's position.

"We will fly outbound from the radio on a heading of 100° for one minute while descending at 500 feet per minute to 700 feet. Then turn right to 310° back to the radio while continuing descent to 300 feet. We should be in the clear at 300 feet but if not, do not descend farther; fly heading 310° for two minutes and then climb back to VFR on top.

"We should be under these clouds before arriving back at the radio. The target should be easily recognized from the description given us, but if you are not sure, don't fire. Remember, the target will be marked with red smoke and the forward friendly positions with yellow smoke. Plan to fire six pairs in each of four ripples. We may not get more than one pass.

"Any questions? OK, let's be on our toes. This could be rather ticklish, but it will work. FAA might not approve of this procedure but I'm sure that company down there would."

As the platoon leader turned inbound toward the company's radio, he broke out of the clouds right at 300 feet and requested immediate marking of friendly positions and the target. Only seconds after the red smoke ignited in the treeline, the first of the helicopters' rockets slammed into the target.

The company mounted an assault on the fortified treeline immediately after the last helicopter's firing pass. The enemy, surprised and dazed from the impact of 192 2.75" rockets, offered only light resistance.

The infantry company was thankful for the much needed support and the aerial artillery platoon was justly proud of a job well done. They reported to their higher headquarters that support had been given to the company, but not how it was accomplished. How it was accomplished was reported only to their buddies at the bar that night.

On another day, the pilot of an 0-1 and his observer were cruising

along on a daily reconnaissance of their area of responsibility. It was a beautiful day with just a few puffy cumulus clouds, a bright sun reflecting from the rice paddies and canals below, and a cool breeze blowing in from the South China Sea.

The observer was almost daydreaming as he thought of how well he knew his area of responsibility. Every canal, every paddy, every treeline and every hootch were familiar to him. He thought of how he had watched daily the countryside below turn from the brown of the dry season to the lush green shades of the wet season. He had seen the rice planted and watched it grow until it now stood tall and nearly mature.

Today the rice, the coconut palms, the reeds and rushes along the canals, and all of the broad

The infantry met little resistance after the helicopters' firing pass

leaf tropical plants seemed to be alive as they bent and waved in the brisk breeze below. It looked as though someone had taken a giant comb and combed the entire countryside into the direction the wind was blowing. Virtually every sprig of vegetation was bent with the wind except about two dozen clumps of tall green reeds along the sides of two intersecting canals. The observer wondered momentarily why those clumps of reeds did not bend and sway. Were they some type of stiff reed with which he was not familiar?

He picked up the binoculars to take a closer look. The clumps of reeds appeared to be the same type as the others around them, but they were not bending in the wind because they were pulled together and tied at the top.

The observer called this to the pilot's attention, and they decided to take another look from a lower altitude. On a pass at 500 feet, it appeared to the pilot and observer that something was hidden in each clump of reeds, but they could not tell what it was. No personnel were seen and no ground fire was received on the pass at 500 feet, so they decided to make a pass at contour altitude. This pass, only a few feet above the reeds, revealed a carefully concealed enemy bunker, foxhole, or gun position in each clump of reeds. It also revealed, by the ground fire received, that at least a portion of the positions were occupied.

The pilot climbed the 0-1 to a safe altitude and reported to the area commander. He reported the number and location of the positions, but he did not report how they were discovered. How they were discovered was reported only to his buddies at the bar that evening.

Just as in the stories above, how many lessons have been learned and new tactics, techniques and procedures developed never to be disseminated farther than to a few buddies at the bar? How many costly mistakes have been repeated and lives lost as the thousands of Army aviators, who were not one of the buddies at the bar, searched for effective tactics and techniques which had already been employed but not shared?

The principles of war never change, but the tactics, techniques and procedures used in the conduct of war must constantly be changed, improved and modified to retain optimum effectiveness.

It looked as if someone had taken a great comb and groomed the entire countryside into the direction the wind was blowing . . . the only trouble was, a couple of dozen clumps of reeds were not combed. A low pass brought interesting results . . .

Many factors influence the development of new tactics and require changes or modifications of existing tactics. The objective, the environment, the enemy, and the introduction of new weapons systems are but a few of these factors. Rarely are tactics developed in peacetime, and none can be judged effective until they have been tested and proved in battle.

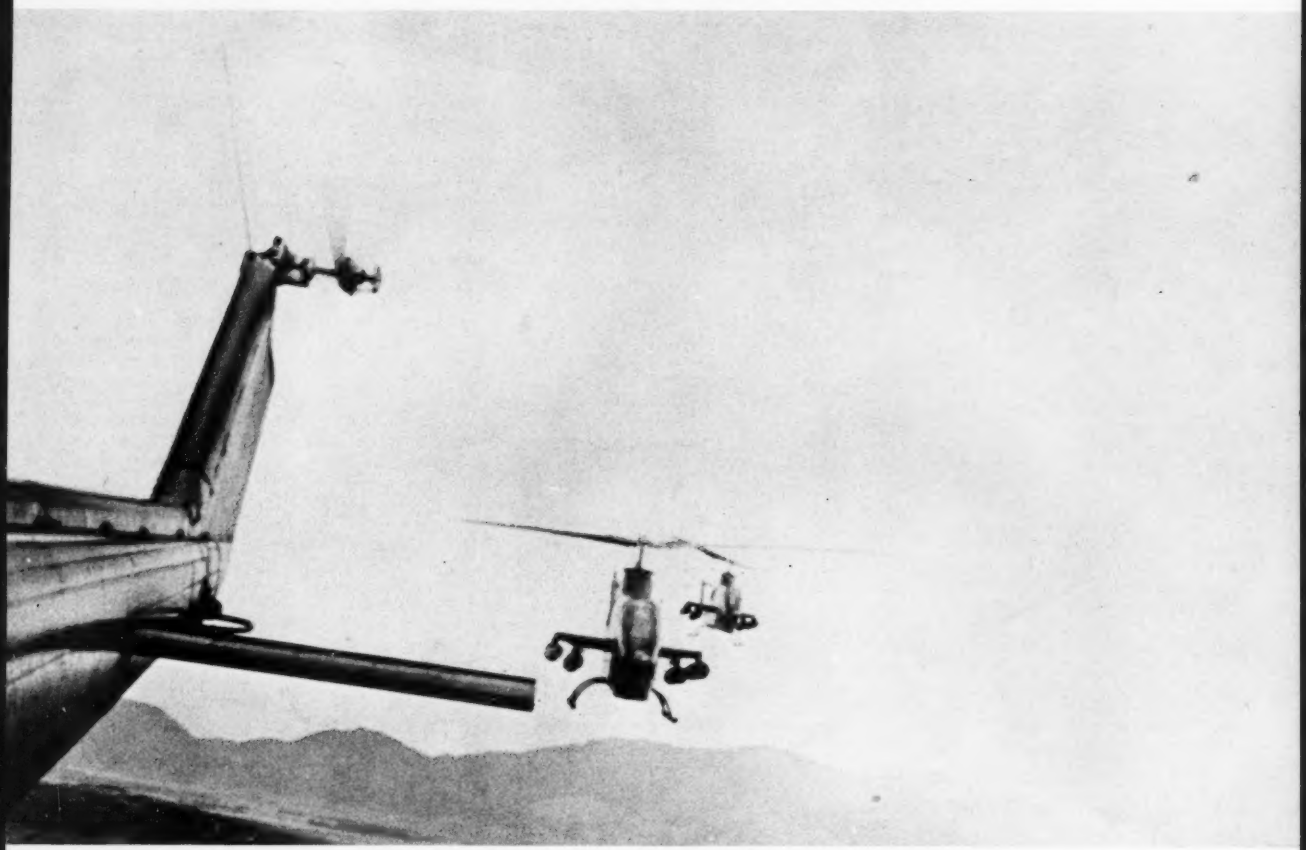
While the development and modification of tactics is a continuous process, changes do not often come about suddenly or dramatically. Changes and improvements are a result of the lessons learned, trials and errors, successes and failures and experience gained by individuals and units in all phases of combat. Each individual and every unit commander must ensure that his trials, errors, experiences and lessons learned are reported so that others may benefit from them and develop more effective tactics, techniques and procedures.

The primary means of disseminating information is through doctrinal publications and training literature. These include field manuals, training circulars, training and special texts, reference notes, Army training programs and special publications. The personnel who prepare these publications are not fountains of all knowledge; they have no crystal balls; they cannot disseminate information which is not reported. They depend on you, the individual on the scene, to provide the much needed information.

The U. S. Army Aviation School is training hundreds of new aviators each month. If these aviators are to avoid the mistakes and errors made by others before them, they must be given the benefit of previous experiences and trained in the latest and best possible tactics, techniques and procedures. This can be accomplished only if the improved methods, experiences and lessons learned by those on the scene are reported.

Any new concepts, ideas, or experiences should be reported of course through the proper chain of command. In addition, a letter or note addressed to the Commandant, USAAVNS, Fort Rucker, Ala. 36360, will get to the proper agency for dissemination and incorporation into the training program.

Remember, the next time you have any information which may be useful to others in your profession, don't be bashful. Tell us a war story, Mac.



Aerial Rocket Artillery

An essential component of airmobile forces, the aerial artillery provides an invaluable means of delivering decisive firepower on an elusive, fast-moving enemy operation on an ill-defined battlefield

Major Warren E. Mullen

THE AERIAL ROCKET artillery battalion is a unique and highly effective combat organization. Prior to the recent organization of the 101st Airborne Division (Airmobile), there was but one such unit in the Army — the 2nd Battalion (Aerial Rocket), 20th Artillery assigned to the 1st Cavalry Division (Airmobile) in Vietnam. The singular successes of this unit have established aerial rocket artillery — the ARA — as an essential component of future airmobile forces.

Born of the airmobility exercises conducted in jackpine and swamp covered lowlands of the Southeastern United States, the aerial rocket battalion met its first real challenge in combat over the steaming jungles of the Republic of Vietnam. In that arena, the ARA has proved well suited to both conventional and counterinsurgency warfare. Aerial rocket artillery is an invaluable means by

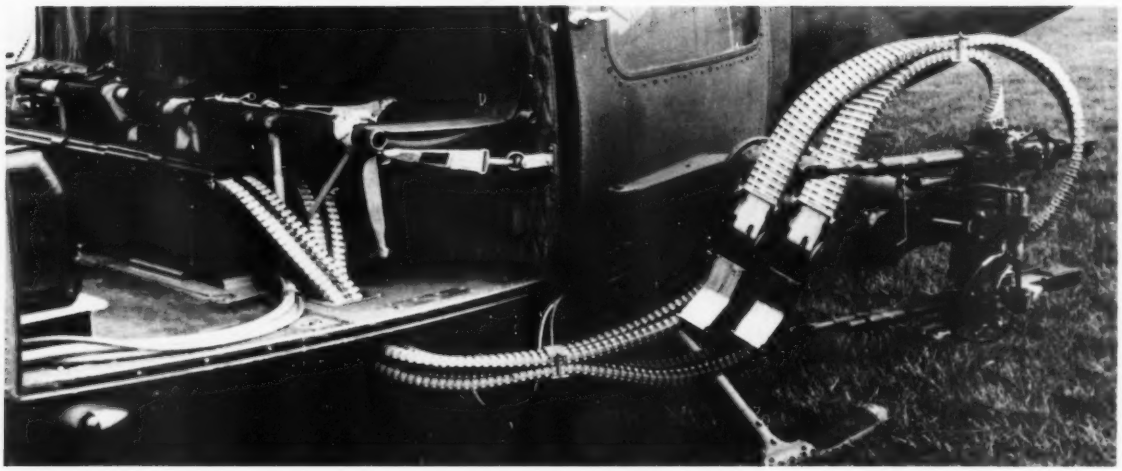


Figure 1: M-6

which the airmobile force commander may bring decisive firepower to bear on an elusive and fast moving enemy on an ill defined battlefield.

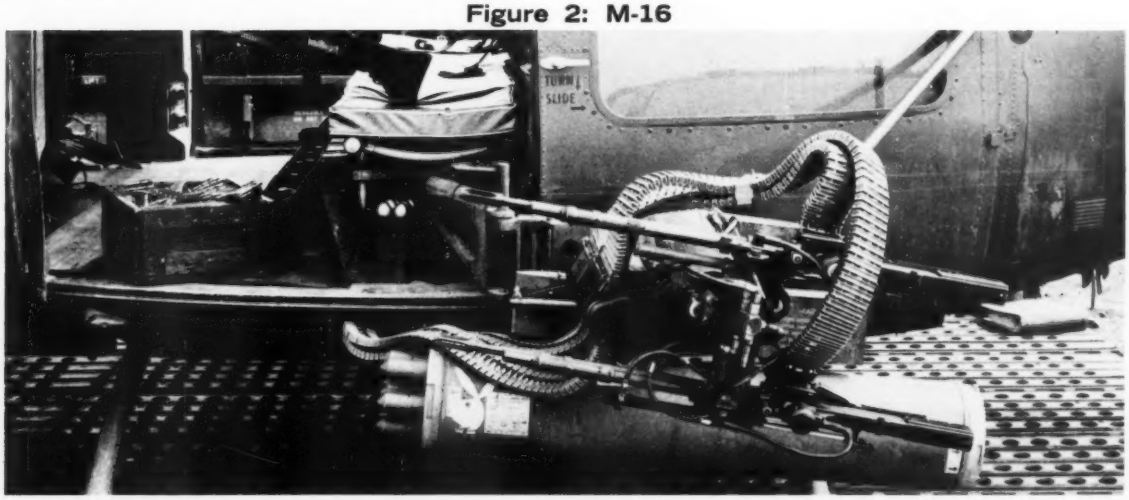
The airmobile divisions are characterized by rapid movement and overwhelming firepower. All fire and maneuver elements are adapted to movement by air, often to locations far removed from the division base camp. Through airmobility, the division exploits the advantages of surprise and initiative; and through aerial resupply and displacement maintains superior firepower and maneuverability on the battlefield. Particularly suited to the airmobile concept is the artillery helicopter, a fast moving and hard hitting fire support system capable of rapid and effective employment over a large area.

The aerial rocket artillery battalion is equipped with 39 helicopters (Hueys and Cobras), three UH-1Cs assigned to the headquarters battery and eight UH-1Cs plus four AH-1Gs to each of three firing batteries.

Headquarters aircraft are used in varying roles. Their primary purpose is to support command and control, liaison and reconnaissance functions. They are also employed, although less frequently, in battlefield surveillance, reconnaissance by fire, target acquisition and suppressive fires in support of infantry combat air assaults.

Headquarters aircraft are variably equipped to best support the current mission. Installed weapons systems may be M-6 (four 7.62 mm M-60 machineguns on flexible ex-

Figure 2: M-16



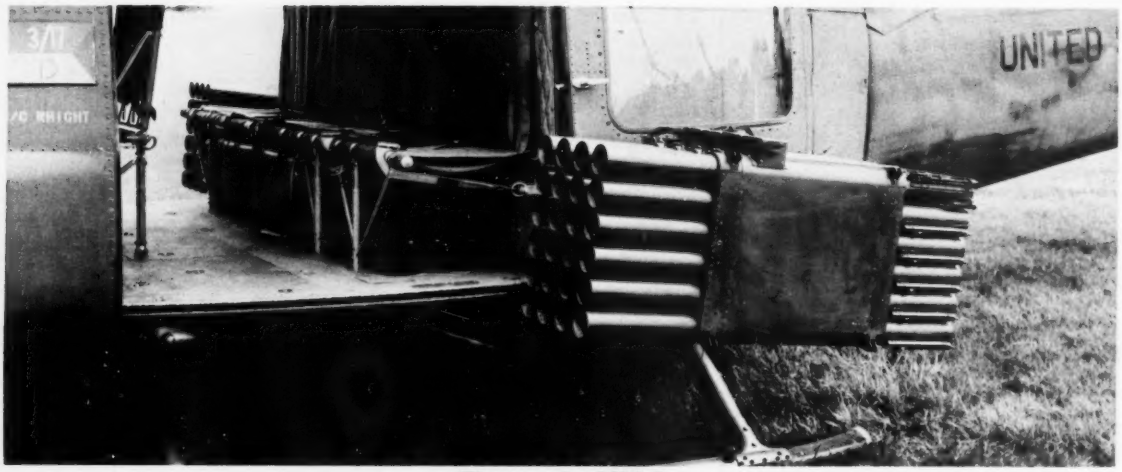


Figure 3: XM-3

ternal hydraulic mounts, figure 1) or M-16 (M-6 with the addition of two external pods each carrying seven 2.75″ aerial rockets, figure 2). Special purpose equipment is frequently mounted. Smoke dispensing devices are installed for use against personnel in well-protected positions such as tunnel complexes or caves.

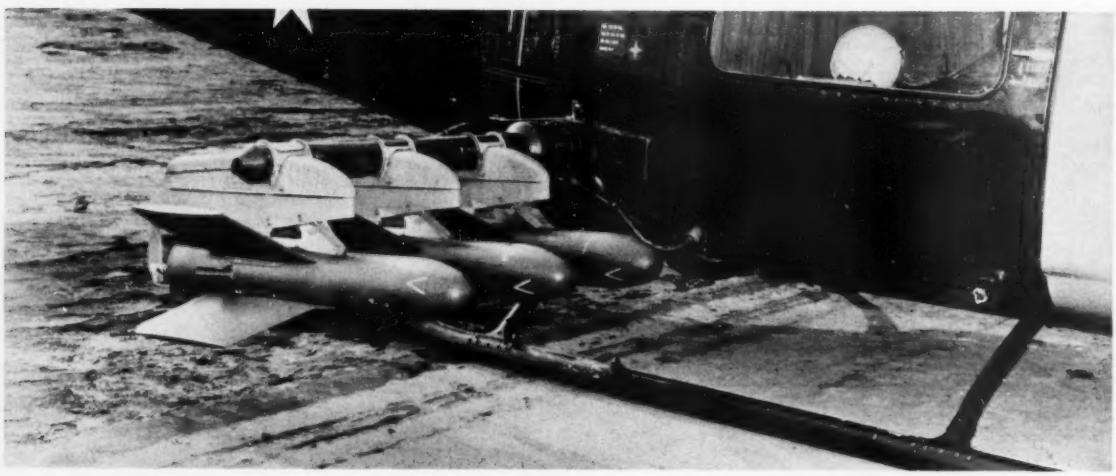
The various weapon systems and special purpose equipment may be quickly installed or removed, and are fully adaptable to any of the battalion aircraft.

UH-1 helicopters of the firing batteries are normally equipped with the XM-3 rocket system. Forty-eight launching tubes are assembled into two pods mounted on external brackets on either side of the aircraft (figure 3). Each ship, armed with 48 2.75″ folding fin aerial rockets, carries the initial striking power of a full battalion of 105 mm howitzers.

Each firing battery is also equipped with four M-22 missile systems (figure 4). The M-22 (SS-11) installation provides fire control and test equipment for six wire-guided missiles, suspended from mounting brackets extended horizontally on either side of the aircraft.

Within each battery, certain aircraft have been modified to incorporate the M-22 guidance and test equipment as permanent features. In these aircraft, the normally mounted XM-3 rocket system may be removed and the M-22 missile system installed and tested in two or three hours, allowing flexibility in the choice of weapon systems.

Figure 4: M-22



The ARA can respond to a call in less than two minutes

Although possessing a dual weapons capability, the aerial artillery battery's most frequent mission is to provide rocket artillery fire support to the airmobile force commander. To assure maximum effectiveness, aerial rocket artillerymen are trained for quick response. Less than two minutes after a call for fire, the ARA weapon systems are airborne and en route to the target area.

One of the most distinguishing and valuable features of aerial artillery is the ability to place a tremendous amount of fire on a specific target without adjustment. Accurate aiming devices and well trained crews ensure first round fire-for-effect capability. Direct observed fire affords immediate strike assessment. Shifting of fires can be almost instantaneous — a formidable tactic against multiple or fleeting targets.

From the 1st Cav's base camp at An Khe, the ARA has responded to calls for support from U. S. and allied forces stretched across the central highlands from the Cambodian border to the South China Sea. The tactical influence of its aerial artillery extends well beyond the division's normal tactical area of responsibility.

Rapid response, speed of movement, extensive radius of action, large volume of fire and first-round - on - target accuracy have made the aerial rocket artillery battalion an invaluable member of the fighting first team in Vietnam.

The unit did not achieve its outstanding effectiveness without effort. Certain aspects of aerial artillery operations require continuous emphasis; among them communications, logistics, and flight crew training.

Effective command and control require continuous communication between aerial rocket artillery elements at the division base camp and in the airmobile task forces' areas of operation. ARA teams may be deployed simultaneously in several locations, each exceeding a line-of-sight distance of 120 kilometers from rear area command post locations. Radio communications across such vast reaches of mountainous jungle, most of which is inaccessible to radio relay teams, require both ingenuity and technical competence to establish.

Relays must be set up wherever secure terrain is available, however poorly it may conform to equipment technical requirements. Limitations in available real estate may require circuitous signal paths, necessitating additional relay points to maintain efficient communication links. Where sufficient ground radio relay sites cannot be secured, airborne relay stations may be established. In either case, equipment organic to the ARA is frequently employed near the prac-

During sustained operations, rearming must be completed quickly

tical limit of its range capability, requiring careful siting, precise adjustment and high maintenance standards.

From alert positions at the 1st Cav's base came, aerial artillery aircraft can support certain small scale, wide ranging operations. Among these are limited objective assault preparations, fire support for long range reconnaissance patrols and ambush reaction forces, fires denying the enemy unrestricted use of key terrain and protective cover for convoy movements. For sustained operation in forward locations, however, the ARA is normally located near the supported airmobile force artillery command post.

Co-location in forward support areas affords several advantages, among them mutual security, close and direct fire support coordination and current intelligence. The chief advantage, however, is the reduced time of movement from alert positions to targets as they develop.

Location in forward tactical areas poses an immediate requirement for independent fuel and ammunition resupply. Reliance on joint-use facilities is seldom satisfactory. During sustained operations rocket helicopters must swiftly refuel, rearm and return to the target area. There can be no question of priorities in the use of servicing equipment or arming points. Additionally, the ARA operations elements must exercise control over expenditure and resupply rates as they are affected by tactical actions.

In some instances the aerial artillery unit may provide a portion of its own logistic support through surface or air transportation of fuel and rockets. In most cases, the necessary resupply is accomplished by cargo helicopters of the division's assault support helicopter battalion.

To achieve maximum effectiveness in aerial rocket artillery fire support, continuous and detailed training must be conducted in tactical radio communications, maps and terrain analysis and ARA tactics and techniques.

Within the aerial rocket artillery fire team, the functions of command and control and of fire direction usually require communication with two or more agencies simultaneously. Among these are ARA operations centers, forward observers, aerial observation posts, liaison officer and artillery fire direction centers. Coordination is frequently required with other fire or maneuver elements, which might include cavalry scout or weapons aircraft, general support conventional artillery fire direction centers, forward air controllers and troop lift aircraft. Using UHF, VHF and FM radios, the team leader is often hard pressed to sort information and avoid confusion.

The team leader cannot always listen to everyone himself. He must often assign certain frequencies to other pilots in the flight and specify a common channel for command and control. Pilots must be well trained in the unit SOP for communication checks and frequency changes. The flight leader must be assured that he has positive control of every aircraft in the flight.

The possibility of radio failure must be recognized. Failure to establish a procedure for immediate transfer of control can seriously delay a fire mission or result in friendly casualties. Training must ensure that control of the flight will quickly and smoothly pass to

the senior aircraft commander having positive contact with the fire control agency; and that no one will fire until he has received positive information describing the target and friendly troop dispositions.

In aerial artillery operations the ability to swiftly analyze map and terrain features is at a premium. Time does not allow a casual cockpit study. Crews must quickly determine the best route to the target area (considering weather, terrain obstacles and enemy weapons locations); accurately locate the target and evaluate those terrain features which will influence tactics; and precisely navigate to the desired attack position. Every pilot must be highly proficient in plotting map coordinate and checkpoint data, interpreting map symbols and recognizing terrain features.

The range of ARA operations required a large area map coverage to be carried in each aircraft. The necessity for great detail in terrain analysis requires small-scale tactical map coverage of that same large area. It is not unrealistic to contemplate employment over a region requiring 40 to 60 map sheets for complete coverage.

Inability to locate the correct map at the right time can result in unnecessary confusion and delay in fire support. Even more serious is the possibility that a flight could run out of map coverage enroute to a target beyond the normally anticipated ranges of ARA employment. In solving these problems, methods have been developed for organizing extensive area coverage into a series of composite maps carefully indexed and stored in a cockpit-mounted container for ready selection and use. To make the system effective, aviators must be trained to use it correctly.

The effectiveness of aerial artillery depends largely on the method of attack and distribution of fire. ARA tactics must conform to the size, nature and orientation of the target. Crews are assigned a wide variety of targets, each requiring a different analysis.

The size and nature of the target dictates the size of the fire team, which may vary from two to 12 aircraft, normally not exceeding four. A symmetrical area target may require attacking aircraft to fire simultaneously from a line abreast, each with a given sector, delivering the maximum volume of fire in the shortest time. A narrow linear target such as a ridge line or stream line may require aircraft to fire from a trail formation, the second and succeeding helicopters 400 to 500 meters behind and to one side of the preceeding aircraft, each firing a given sector for optimum distribution.

A point target, moving or stationary, may dictate attack by a single aircraft firing from short range while covered by the remaining aircraft in position to provide immediate covering fire. Multiple targets may require multiple directions of attack simultaneously, or sequential attack in order of importance.

Various methods of attack involve certain specifics amenable to SOP. These include approach and

The ARA frequently coordinates with other fire and maneuver elements such as the troops below who are flushing out an enemy command post. A CH-47 brings in more troops

firing formations, time to fire, number of rockets to fire, target sector, direction of the break after firing and emergency actions. Every aviator in the flight must know the various techniques and procedures, and must be able to perform appropriate actions at the proper time without a lot of conversation over the tactical radios.

The flight leader may expend all or a portion of his rockets against a target on a given pass or firing run. The number of rockets to be launched or retained is determined by evaluation of the target and the probable need for subsequent attacks. A balance must be sought between destructiveness of initial fires and retained capability for sustained fire against fleeting targets or targets of opportunity. The target must be quickly neutralized; however, the flight leader must not allow surviving enemy to emerge from cover and freely maneuver while he circles the area with empty rocket tubes.

Rocket helicopters normally carry two door gunners equipped with M-60 machineguns to provide suppressive fires against the target or surrounding terrain during rocket firing or surveillance passes. Effective delivery of suppressive fire requires training in several techniques: visual scanning by sector to detect hostile counteraction, target recognition and identification, delivery of air-to-ground fire and safety procedures.

Gunners must know where and how to fire and when to commence or to cease their engagement. Success of a fire mission often depends largely on the door gunners' ability to protect their aircraft during rocket firing runs on the target.

Aerial rocket artillery fire missions may be categorized as preplanned or on call. Scheduled fires such as air assault preparations and harassment and interdiction (H&I) generally allow time for extensive crew briefings, detailed coordination with air and ground elements and consideration of alternate and emergency plans. Commanders may carefully determine who shall fire upon what and in which manner.

On-call fires from orbit or from alert positions on the ground require immediate response; time is not available for preflight planning. The flight leader must depend upon his judgment and upon the prior training of his crews. It is therefore necessary that all rocket artillerymen continue to develop skill and judgment through continued study of ARA tactics and techniques. The work of tactical planning must be accomplished on the ground before the mission — not in the air afterward.

It has often been stated that every artillery aviator should remain proficient in conducting conventional artillery observed fire. This dictum most surely applies to the aerial rocket artilleryman. In several instances, ARA aviators have successfully adjusted and coordinated the fires of direct support and general support conventional artillery and rocket helicopters against moving troop concentrations. On other occasions they have been called upon to adjust conventional artillery on targets obscured from direct observation by forward observers, or to continue adjustment for forward observer casualties. It appears likely that ARA pilots will continue to be called upon to conduct conventional artillery fire missions, and must therefore remain well trained to do so.

UH-1B and 1C helicopters were not designed as weapons platforms, and were not intended to carry the loads habitually placed upon them in aerial artillery batteries. The added weight of the XM-3 armament system (48 rockets), two machineguns and ammunition, emergency radio and signal flares, survival kits and four crewmembers with individual weapons and protective equipment brings the aircraft very close to the maximum allowable gross weight for standard sea-level conditions of temperature and pressure.

In the heat and humidity of the Vietnamese jungle, particularly in the higher terrain of the central highlands, aircraft frequently operate at surface density altitudes ranging from 4,000 to 5,000 feet and occasionally higher. Under these conditions the UH-1B can no longer operate at the maximum design gross weight. A reduction in fuel, rockets or crewmembers becomes necessary, diminishing the combat capability of the weapon system.

To maintain the highest possible combat effectiveness, ARA aviators must normally fly their ships at maximum gross weight for existing conditions — a circumstance requiring unusually careful flight techniques. In the fully loaded rocket helicopter every takeoff must be treated as a maximum performance maneuver. Introduction of the Army's attack helicopter, the AH-1G Cobra, specifically designed for aerial weaponry, has significantly increased rocket helicopter speed, range and firepower. As ARA fire support capability increases, new concepts will be required in armament, employment, communications, logistics and tactics.

Since its inception, the aerial rocket artillery battalion has been singularly proficient in the fundamentals of artillery — to move, shoot and communicate. With continued emphasis on training and the development of effective SOPs for communication, logistics, and the conduct of fire, success will be assured.

USAASO Sez

The U. S. Army Aeronautical Service Office discusses

Overhauling GCA equipment
New 1;500,000 Tactical Pilotage Charts
New policy with FAA on parachute jumps
Getting GCA operators' ideas into manuals

ON navaids: Every try to uproot an AN/FPN-40? It can be quite a job if your personnel have never been involved in such a project. The Army's cyclic overhaul program for GCA equipment as established in SB 11-464 has caused some heartburn not only in the uprooting of the equipment, but in installing the overhauled replacement sets as well. Commanders encountering difficulties in installing or relocating GCA or other fixed base navigation aids should take advantage of services available under paragraph 3 of AR 95-23 which tasks USAASO with providing worldwide engineering assistance on design and installation of Army ATC ground support facilities and systems.

ON pilotage charts: There has been a considerable amount of static about the new 1;500,000 Tactical Pilotage Charts (TPC) which have replaced the good old sectional chart used for many years by Army aviators and operations types. As indicated in previous articles in the Flight Information Bulletin, the Army use of the Tactical Pilotage Chart was prescribed by DOD policy. An effort is being made to permit use of the regular sectional edition along with the TPC or to add data to the latter to meet our specific and often unique requirements.

ON parachute jumping: U. S. Armed Forces are no longer required to notify FAA prior to making parachute jumps within armed forces' restricted airspace. Previously, Part 105.23 of the Federal Aviation Regulation prohibited parachute jumping in or into certain parts of the airspace unless appropriate prior notice was furnished to the nearest FAA Air Traffic Control Facility or FAA Flight Service Station. Now an amendment says Section 105.23 does not apply to parachute jumping by members of an armed force within a restricted area that extends upward from the surface, when that area is under the control of an armed force.

ON GCA manuals: Ground controlled approach (GCA) operators have long labored with technical manuals that did not always meet operator needs. USAASO wants to crank the operators' ideas and needs into these manuals. Take a look at TM 11-5840-293-12 (FPN-40) and TM 11-5840-281-15 (TPN-8/18). How can they be improved? What's missing? Put your ideas down on paper and send 'em to:

Director, USAASO
ATTN: Flt Fac Div
Cameron Station
Alexandria, Va. 22314

Now is the time to move on this one. The -15 (TPN-8/18) is in the process of being revised and the other is overdue for revision (insofar as operators are concerned).

Two Minutes:

the most important of your life

He rushed himself and exceeded his capability. Had he taken two extra minutes — one outbound and one inbound — he'd have done better (and passed the check ride)

Major Glenn A. Leister

AT 0620 MAJOR Blastforth, a senior aviator, arrived at airfield operations to accomplish his annual instrument renewal ride. He had a fair amount of experience flying instruments in U-8 aircraft a few years ago; however, he has just returned from Vietnam and hasn't been able to do much instrument flying. He naturally was a bit apprehensive about the flight check but his fears subsided a bit when a rather shy young warrant officer walked up and introduced himself as the instrument flight examiner.

During the preflight briefing the examiner asked if the major was familiar with DOD FLIP charts and if there were any questions.

The major felt a slight uneasiness in his stomach, but having accomplished a recent IFR flight, he quickly replied he was prepared to file the flight plan. The weather was below VFR conditions and he felt confident the examiner would not be giving simulated single engine procedures or anything unexpected.

When the major completed his flight plan, the flight examiner noted that enroute VOR station identifiers had been entered in the TO block of the 175 instead of ONLY the point of intended landing. (FLIP Planning Data and Procedures, Sec II; Pilot Procedures.) After this and a few other minor errors were corrected the flight plan was filed with operations. Destination weather was forecast to be 800 feet overcast and one mile visibility with VOR and ADF approach facilities. The alternate selected was forecast to be 600 feet overcast and two miles visibility and was not listed as an exception under "U. S. Army Alternate Airport Weather Minimums" [near the front of the DOD Flight (Terminal) Instrument Approach Procedures]. The alternate airport had complete ILS, ADF and VOR approach facilities.

The departure was uneventful except that Blastforth would have overshot his SID altitude restriction but luckily ATC cleared him to continue climbing to an assigned enroute altitude. Having obtained radar contact after takeoff he was relieved of demonstrating his knowledge of reporting procedures.

Upon arrival at his destination Blastforth's confidence increased. He had been previously assigned in the area and his last instrument flight was to the same airport. Due to traffic conditions Blastforth was cleared to hold at the VOR station on the inbound course, procedure turn side, one-minute patterns, maintain 4,000 feet. Airport elevation was 305 feet.

So far so good. Blastforth finally pinned down a good inbound heading to fly and was tracking with the VOR needle almost centered. As he was turning outbound from the VOR he was cleared for a VOR approach to Pittsville airport. Blastforth yanked off the power to expedite descent and went outbound one minute. He also reported VOR outbound, which is not required by approach control.

While outbound and descending he glanced at his approach procedure and after one minute began a turn to the inbound course to the VOR. Procedure turn (PT) altitude was 2,500 feet MSL and since he thought he knew he was near the inbound course he continued descending to 2,000 feet MSL which was the minimum altitude authorized inbound to the station. The rate of descent was 1,500 feet-per-minute. Things began happening fast now.

The heading indicator was approaching 360 degrees (inbound course) — stop and turn, OK, now, whoops — gotta stop that descent, whoo! Just a hundred feet low, now back up to 2,000 feet. Hold it, what's the matter with the VOR? Full scale left deflection! Better make a good size correction to get on course. Let's see, what was that minimum altitude on final and time inbound? Oh yeah, got it now. *#@!@#* it!! Now the VOR is full scale right deflection. Another turn.

Then the TO indicator went to FROM on the VOR. Again Blastforth yanked the power off and dropped the gear to attempt to salvage the approach. A few more S turns and the VOR deviation needle is only five degrees off course. Thirty seconds left to go on time inbound from the VOR to the airport and it looks like Blastforth has salvaged the approach and leveled off just a hair below minimums: ground in sight but no airport or forward visibility.

At this point the examiner instructed Blastforth to initiate the missed approach procedure. Anticipating a full stop landing, Blastforth was a bit confused, particularly since he figured 30 seconds were remaining. The examiner realized the time from the procedure turn point inbound was less than 45 seconds, indicating a tailwind on the approach. Therefore the time inbound on the approach would be shortened. Since the minimums were 800 feet and one mile, the field should already have been in sight, but since VOR and ADF are nonprecision approaches it is not uncommon to fail to be aligned with the runway as you should be with ILS or GCA which are precision approaches.

Blastforth fumbled for the missed approach procedure, but with some welcome copilot assistance from the examiner he managed to initiate the missed approach.

Informed that Pittsville airport was below minimums, a change enroute flight plan was filed and a clearance obtained to Podunk airport. Upon arrival at the alternate Blastforth was relieved to find that winds from the ground to his altitude were light and variable. Weather was 200 feet overcast, one-half mile visibility, with light rain and fog.

An almost identical situation occurred. The clearance for approach was given in a similar holding position, except this was to be an ILS approach. Again Blastforth went outbound only one minute and turned inbound. The MAJOR factor that was to be a problem during this approach wasn't wind — it was *unfamiliarity* with the approach to Podunk airport. This time the pilot was rapidly glancing at the approach procedure and trying to control heading and altitude, which were persistent in remaining

almost out of tolerances. Suddenly the glide slope came off the peg and moved toward the doughnut . . . course needle was slowly moving away from center. Blastforth was confused with an unfamiliar format on the approach procedure! What was DH? MDA? HAT? Why was an A - B - C - D - E above each column? By this time the ADF needle was off the tail and both LOCALIZER and GLIDE SLOPE were fully deflected.

At this point the examiner stated, "I've got it!" and requested clearance for another approach. He proceeded back to the outer compass locator, went outbound two minutes on a teardrop procedure turn and reversed course. During the two minutes inbound he intercepted, bracketed and tracked on the localizer, reducing heading changes down to two to three degrees. The localizer needle was centered, and as the glide slope needle moved to the center, the gear was extended. Very few corrections were necessary during the final approach. The approach was executed with precision because he had allowed himself sufficient time to stay well ahead of the aircraft without rushing the sequence.

"Why not expedite the approach?" ask many pilots. It can be done however it is an exceptional pilot who can make a precise approach under the adverse conditions described above.

The primary objective of an instrument flight is to arrive safely at destination. Blastforth thought he was in the "ball park" on both approaches. Was he?

Let's analyze the obstruction clearance criteria on an ILS approach. This is not "protected airspace" from other aircraft, but the safety zone between you and obstructions!

This area assures terrain clearance when the aircraft is within the boundaries of the airspace approach segment and at the published altitudes. Descent below procedure turn altitude should never be started until intercepting the glide path on a full ILS approach, at the final fix inbound on a localizer approach, or when established inbound on final course in accordance with the altitude shown on the published VOR or ADF approach. (Blastforth was descending too early on the VOR approach.)

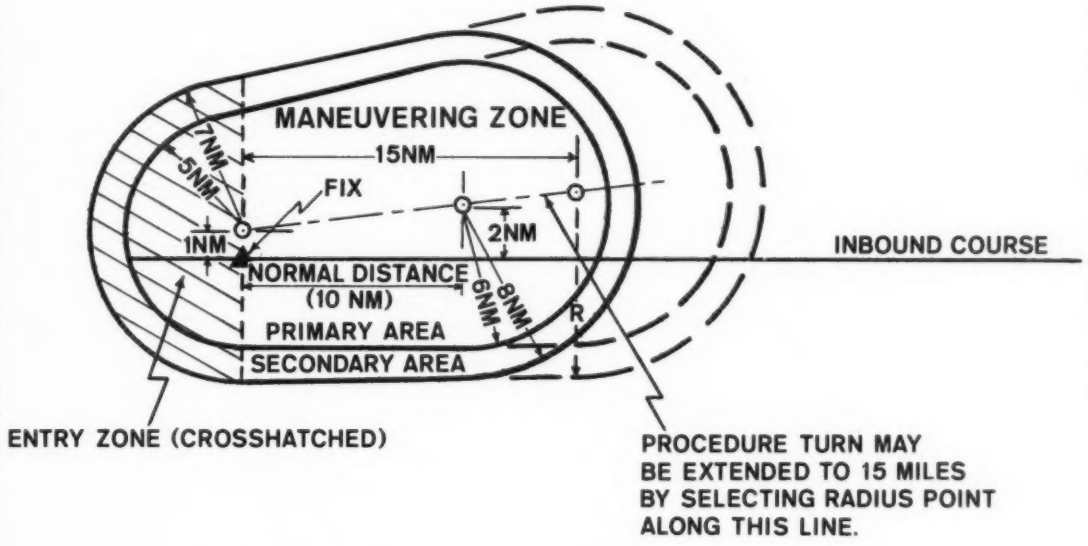
Note how narrow the safety zone becomes as you approach the airport: 500 feet either side of centerline and 200 feet above the terrain. A full-scale deflection on either LOC or GS could mean your flight might terminate in a sudden stop short of the airport. A turning missed approach procedure also is not as safe as you might think. If you delay your turn, or fail to compensate for a tailwind on your approach time inbound from station, you may not have obstruction clearance.

The ironic part of this story is that although the names are fictitious, this story is repeated every day by numerous pilots — military and civilian. Blastforth is probably an average pilot. He rushed himself and exceeded his capability. Had he taken two extra minutes — one outbound and one inbound — he could have been much more precise (and passed his check ride). With regard to overshooting altitudes, his crosscheck wasn't slow, he was descending or climbing too fast -- FAA requests no more than 500 fpm rate of climb or descent the last 1,000 feet to an assigned altitude. This is the human factor. Double the amount of tasks (or crosschecks) to accomplish in a short length of time and the outcome is doubtful. The same principle applies to an approach. The human reaction, for example, at 200 — one-half minimums: if descent is 1,500 fpm, only an exceptionally good pilot will consistently stop his descent without "busting" minimums. Rates of descents and tasks in the cockpit MUST NOT EXCEED normal crosscheck capabilities.

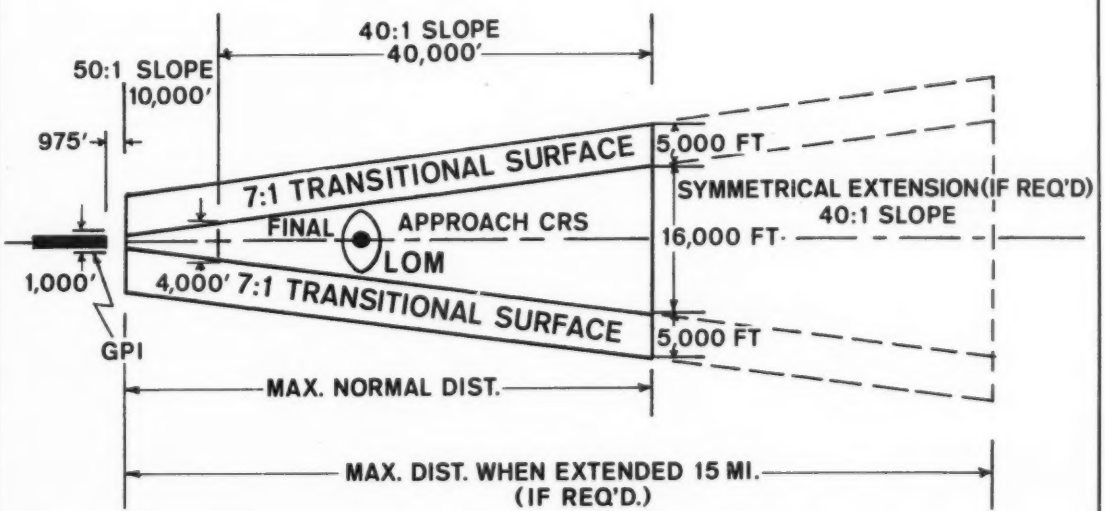
If cleared for a straight-in approach the controller generally must give clearance at an altitude and heading commensurate with the inbound course and altitude. When a pilot "rogers" a clearance, he "signs" a contract that he can comply. If he's not in position to comply, he should request a standard approach and/or radar assistance. The controller must maintain a two minute or a five mile horizontal separation of 1,000 feet vertical separation between you and other aircraft. You don't have three miles or 1,000 feet between you and obstructions — you may have as little as 200 feet vertical or 500 feet horizontal clearance from the ground.

So what if IFR traffic is heavy? Have you expedited anything if you have to make a missed approach? It may be worth it to take the extra two minutes.

NORMAL PROCEDURE TURN AREA ALL AIRCRAFT



ILS CATEGORY I FINAL APPROACH AREA



Let's Quit Killing Ourselves

If you insist on ignoring what you've been taught, be sure that you wear your dog tags when you're flying

Major Noel Q. Nichols

WHEN DID YOU look at USABAAR's "Weekly Summary" without seeing:

"Aircraft lost rpm on takeoff" or "high density altitude considered a factor"?

Do you suppose that rpm just dropped off from 6,600 to 5,800 or lower all by itself? And how about that density altitude? Do you think it jumped from plus 1,000 feet to plus 2,500 feet just as the pilot prepared to pull pitch?

In a recent safety meeting the thought was presented that aviation fatalities resulting directly from aircraft accidents exceed aviation fatalities resulting from hostile fire in Vietnam. Although many, many helicopters have suffered hits in and around "hot" LZs or when low leveling over the jungles, it seems that for the number of rounds shot at us by "Charlie" he is a lousy shot. We unfortunately do a remarkable job of making up for his inaccuracy by overloading our overworked Hueys in valiant efforts to accomplish the mission. It is tragic that so often our judgment is clouded by "mission accomplishment above all else." The results frequently are seen in the number of aircraft lost and destroyed, along with a loss of life that cannot be measured in dollar figures.

It is time we — not USABAAR or safety specialists but you and I — started taking a serious look at this problem. Wiping out an infantry squad in a helicopter crash is not only an expensive tragedy, it seriously impairs our overall combat effectiveness. Forget the dollars and cents aspect of the problem, as serious as it is. Think instead of lives, mission accomplishment and additional lives which might be lost because of a wiped-out squad.

To find a solution to this tragic problem we have several courses of action, all of which require a strenuous effort on the part of every Army aviator from the top down to the newest student at Wolters or Rucker. First, of course, is a serious examination of our own capabilities. That young warrant officer, fresh in-country after successful completion of flight school and a 30 day leave, probably is sharp at the controls and really gets around on his local-area checkout. Next take a major who is a senior Army aviator — he's been around a long, long time. He flew OH-13s in Korea and now, after a tour at an Army headquarters, has a lot of U-8 time. Put the major and the warrant officer together on a mission right after their arrival in the unit — a resupply or troop lift mission — and you have an accident about to happen!

Take a couple of captains right out of a 25-hour UH-1 qualification course. First mission in-country is resupply — hauling ice, gasoline, spare parts and a few passengers when room in the aircraft permits. You will be lucky if only the colonel's tent gets blown down as they stagger off the ground, low rpm warning light on and obnoxious noises coming through the headset. But, these guys have a lot of hours in fixed wing and have been around — no sweat!

If the folks we've been talking about make it through their first few missions they will probably make it through their tour. They'll have a few grey hairs but will speak with a voice of experience when talking about overloaded aircraft and high density altitudes.

Most units have a policy that "new guys" get broken in by riding with the "shorttimers" on the first few missions. This is good when possible to arrange but is the newcomer to the unit making only the easy approaches and takeoffs? Does the oldtimer accept any load given him just because it is there and because he knows a few tricks about getting an overloaded bird off the ground?

The attitude often passed on by oldtimers, "If it will hover it will fly" can be deadlier than putting the most inexperienced aviators on the toughest missions. A couple of young warrant officers or lieutenants fresh from Rucker, though lacking in experience, should have the sense to be scared enough to check their load and determine if it is within their capabilities to fly it.

Along with an evaluation of our capabilities and the capabilities of our aircraft, we must also evaluate the aircraft loads in relation to existing conditions. The "dog" of the fleet won't be anywhere near as responsive and powerful as that brand new machine fresh off the boat. *Which* aircraft are you flying today?

We can haul six troops at 0500

with no difficulty. What will the density altitude be later on in the morning? How many troops then? You picked up seven troops last time out of the PZ; since then you have refueled. How many added pounds next time out? You easily picked up a load at a low altitude strip and you are going to the top of a 3,000-foot peak. What's the density altitude going to be there? What if you have to terminate at a hover?

If we start doing some better checking more of us will come back from our tour unscarred. That Go No-go placard, if used, will prevent all misery but remember it is good for one takeoff at a time. The factors affecting each takeoff must be taken into consideration. You cannot get the same load out of a vertical tunnel formed by a ring of 200 foot trees that you can lift at home base. Just because you had the necessary get up and go at a sea level base camp doesn't mean you'll safely make it on and off that 3,000-foot mountaintop.

The people who make helicopters are fully aware of their performance limitations and our accident statistics. To help us out they are installing a more powerful engine — added power for your overburdened Huey. Too bad some of us are going to crash because of that engine! Just think how much more you will be able to haul in your bird with that added power. Those who take the attitude that the added power is to enable us to do our present job more efficiently will benefit, find their job easier and will live longer. Those who figure on throwing more weight aboard because of more power are in for serious trouble.

Another aspect of the problem is a lack of understanding by commanders. Most of our ground commanders understandably have little knowledge of aircraft and aviator capabilities or limitations. In past years some commanders felt Army aviators were overpaid, underworked flyboys who sometimes contributed a little something to the overall accomplishment of the mission. To our credit, those days are gone forever. Now, our company, battalion and brigade commanders are asking for as much aviation support as we can give them and demanding more and more all the time. As a result aircraft and aviators are sometimes misused, abused and misunderstood.

There is a big task ahead to educate all commanders to properly use the aircraft available to them. One big reason for our existence, lest you forget, is to enable the ground unit to fight more effectively. If we are not filled with a sense of successful mission accomplishment when supporting the troops we are not worth our pay as soldiers. A major undertaking properly and safely accomplishing our mission is to ensure that our machines are always used correctly.

An inexperienced person seeing a Huey pick up eight troops at the airport will assume the same aircraft can take eight troops out of a jungle landing zone and may base his aircraft request on that. Or maybe in the cool of the morning it took 20 ships to do a job normally assigned to 25. You know how many ships that man is going to request later in the day when the density altitude is a thousand feet higher, the crews are tired and everybody is in a hurry to get the job done. Sure, he is going to ask for that same 20 ships.

Brigade aviation officers are in a good position to advise the boss and the rest of the staff on proper utilization of aircraft. The brigade AO should be able to corner the old man now and then and provide him with some pertinent facts. If everyone realizes the design limitations of the machines and the factors affecting aircraft performance they are more likely to request enough aircraft to do the job properly rather than insist on a minimum number of ships so the lift can be accomplished with greater speed. They certainly would rather have an extra sortie or two than an overloaded aircraft crash with one of their infantry squads on board.

Many ground commanders have learned the problems that face an aviation unit, but it has taken far too many accidents to bring the point home. Don't blame the commander! Look to the aircraft commander who says, "Sure I can take a couple more, climb on."

Also we need to think about what we carry on our helicopters. The normal crew for routine missions consists of the aircraft commander, pilot, crewchief and gunner. Each has a personal weapon, ammunition and some sort of armor to sit on, wear or hide behind. Add two machineguns and two or three boxes of ammo for each gun. Throw in a case of C rations, some extra oil, hydraulic fluid, tools and manuals — you've got a good load even before the mission starts.

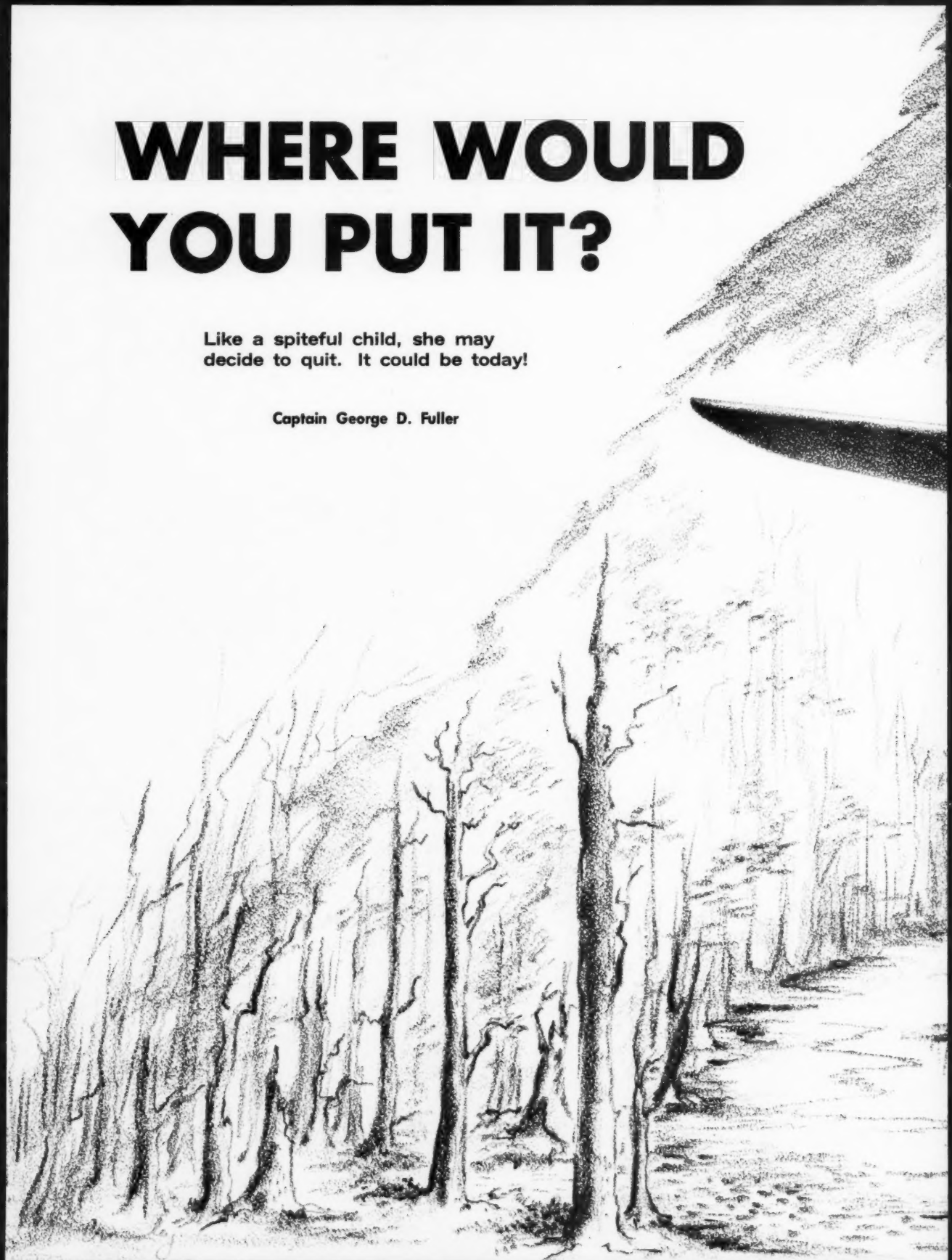
Is it all necessary? When did you last take a look into the heater compartment? What did you find there? How much did it weigh? Was it necessary or was it just dead weight around the neck of aircraft performance?

Enough said? Start thinking then! Get out your dash 10. Brush up on how to use the Go No-go placard and tell the boss what your aircraft and you are capable of doing. Then when you go out to do that job stay within the limits prescribed by the book, your boss and yourself. If you insist on violating what you've been taught and assume the attitude that a few extra pounds won't hurt, be sure to wear your dog tags so you can be identified.

WHERE WOULD YOU PUT IT?

Like a spiteful child, she may decide to quit. It could be today!

Captain George D. Fuller



WHERE WOULD YOU put it?" Remember that question from your glorious days in flight school? It was usually asked by a devilish IP who pulled the throttle back just when you decided to fumble with maps, light a cigarette, or pass a minute or two in pleasant reverie enroute to the home field.

Actually, IPs develop a sixth sense. The technique varies with instructors, but it's rather like the student in a classroom who passes the time by staring at the back of a buddy's head. You concentrate on that spot and see if he will get uncomfortable and maybe look around. It's more subtle of course but by studying the back of your head, the right toe of your boot, or your left knee cap an experienced IP seemingly can tell exactly when your thoughts are on the next weekend. At least mine always could. As surely as night follows day, back comes the throttle, "forced landing" dances through your earphones and the IP chortles smugly. Caught again.

Where Would You Put It? (from page 33)

I've heard it said by some pilots who are no doubt inclined to be mystic that an airplane engine operates the same way. To most of us an engine is simply a rather amazing collection of ingeniously arranged parts and pieces. But a pilot who has flown one particular airplane for a long time tends to think of that airplane as a living being, complete with emotions, whims, and soul.

Put nice fresh oil in her engine and her pilot feels freer, looser. Top off her tanks after a long flight and the pilot feels their mutual hunger satisfied. It's something like the golfer who thinks of his driver as an extension of his arms and the head of his club is a hardened fist with which he will slap a ball far down the fairway.

At any rate some pilots will tell you an airplane *knows* when her pilot is treating her badly. She may cough gently to remind you of a need for carb heat, or sputter in protest at too lean a mixture or wag an accusing needle when oil or fuel pressure loss is making her uncomfortable. The point of all this discussion is that she will try to warn you, her master and friend, that if the ball game or scenery occupies more of your attention than she, your harmonious friendship is about to go down the drain.

Very infrequently are the occasions when she will sit down and quit, blow up or die with a sputter and these are the occasions that drive pilots and safety people up the wall. Not only are the explanations often dubious, but the man-machine harmony has been violated. You *know* you treated her right and attended to her needs but she still, quite literally, let you down. Actually the pilot should not feel anger but a sense of profound sorrow at the passing of a dear friend. After all a reciprocating engine has many moving parts. Consider the fact that throughout the world there are millions of parts whirling, spinning, thrusting, sparking, starting and stopping. Is it any wonder that after lengthy periods of intense dynamic activity a spark plug should stop sparking, a carburetor stop carbing or a piston blows through the cowl while its deserted rod flails the rest of the engine to death in abandoned disappointment? I think not. Sad, yes. Shocking, certainly. But that's Kismet.

Let us assume then that you have through one course or another arrived at the original question. Only now we ask, "Where *will* you put it?"

First of all be calm. You may have wasted precious seconds hoping the engine is still running and you are only temporarily deaf. When this fantasy has passed you must realize you still have a flyable airplane, it's just that you're simply going to have to land a little sooner than intended.

Landing without an engine need not be so alarming — a lot of people (called glider pilots) do it all the time, and enjoy it

Remember, there are a lot of reasonable and responsible people called glider pilots who do this very thing all the time and appear to enjoy it. Maybe the time between now and landing will count toward a glider rating. But between now and then you will have to fly the airplane. There are a few "always" and "nevers" in aviation and this is one: fly the airplane, first, last, and always. Once a glide is established you must answer several questions and make a few decisions, all in the wink of an eye. If you are cautious you may already have thought out several of these in advance.

What is the situation? Day or night? VFR or IFR? What is my altitude AGL? What are the surface winds? Where's the nearest airport? Is that friendly or enemy territory down there? Where are the nearest friendlies? How about a distress call? What is my present location?

Now let's make an improbable hypothetical assumption: *you cannot jump*. For some reason known only to the fates a nylon letdown is out of the question. So if you're on an IFR night cross country flight, for example, you're going to have to ride it down. What to do? Might as well let the man on the ground know about your troubles. ATC takes a Mayday pretty seriously and have a set procedure to follow when someone calls. You can expect him to either compute your exact position or look at his radar to see where you are. If you are near an airport he'll try to vector you to it. If not he will give you the reported surface winds in the area. In either case he will clear the airway traffic below you, tell you where you can expect to break out of the clouds and implement a search and rescue effort.

Now it's up to you. You should head the airplane into the reported winds, hold your airspeed about 10 knots above a stall and run through the emergency check. Now all you have to do is wait until you're about a hundred feet or so above the ground, turn on the landing light, and resolve to try and dodge any trees, wires, fences or buildings that may lie ahead. Not a pleasant prospect, but you've done about the best that you can under the circumstances.

Compared to an engine failure during night IFR, a day VFR forced landing should be a snap. The question is not, "Can I walk away from it?" but "Can I make it in without breaking the machine?" Unless you're over water, swamps,

forests or mountains the answer should be yes. If the land below is cultivated farm land there's almost always a good field within gliding range. The trick now is to pick out the best one. So establish the best glide speed for your aircraft and start looking around. What's available? Corn fields? Probably too soft. Wheat fields? Heavy vegetation may snag the gear and pull you over on your back. Grassy pastures? That should do nicely.

Make your emergency check quickly and maneuver for the biggest pasture you can find that runs into the wind. Plan on landing in the first third of the field, avoid rolling across contours, and drop full flaps when you're sure you have it made. After touchdown all that remains is to dodge rocks, stumps or cows and then give yourself a pat on the back. Your commander will be happy, your friends respectful and your wife overjoyed. You are a minor hero until everyone has heard the story at least twice — so enjoy it.

Between these two examples which represent the worst and best possible cases respectively there remains a multitude of emergency forced landing situations you may want to ponder. For example, if you're at low altitude and airspeed there's not much you can do but accept whatever lies ahead. Hold the best glide airspeed and use just a dab of rudder to dodge any obstacles in your path. Is it winter? You can bet the ground is frozen if it has been pretty cold for a week or two, so nearly any reasonably large field will be good. In the northern part of the country frozen lakes may be your best bet in the dead of the winter. If there's a lot of snow on the ground, be suspicious. Drifts may conceal a gauntlet of hazards ranging from stumps to barns. In that case a country road or a highway may serve you well.

Speaking of highways, you may find yourself gratefully joining the Sunday drivers we so often scorn if the surrounding terrain is forested, swampy, mountainous, or otherwise unsuitable, and nothing better is available. There are a few tricks to landing on a highway that you may not have considered, though. Remember your road strip procedure? You have to look out for culverts, gulleys, washouts, road signs, wires, traffic and so on.

Telephone lines almost always parallel highways and you can be sure telephone or power lines will be in your path where a house sits beside a road. If there's any question in your mind about clearing the wires there is one pretty safe procedure you can obeserve. Point the nose of your aircraft right at the wires. On short final to the wires you must quickly decide whether you have enough airspeed to raise the nose slightly and glide across, or whether you will have to dive more steeply and go under. The latter may smack of barnstorming and run contrary to your inherently cautious nature, but it is certainly better than stringing several yards of high-voltage wires around your airplane, a non-habit forming maneuver if ever there was one.

Forced landing in Vietnam? There's a sky full of helicopters. Call one and get a ride home. Walking could be fatal

Throughout the years that man has taken to the sky some very memorable forced landings have been made on our highways. Remember the fellow who landed on a bridge near New York City? He was probably one of the thousands of pilots whose idea of going first-class is courtesy of Rand-McNally via the concrete omni. Not only are navigation problems simplified, but most of the time we're over a nice long runway.

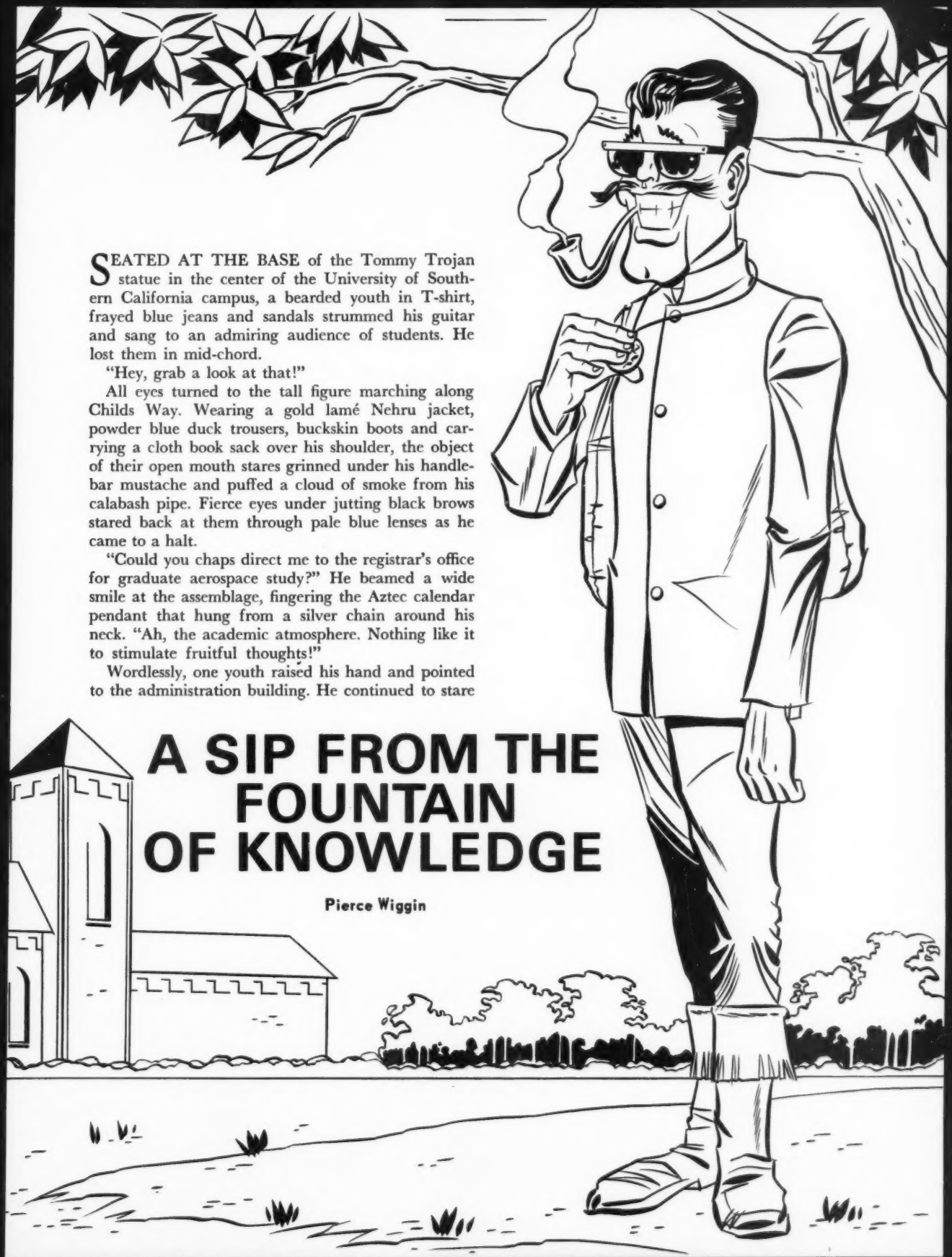
Over nonfriendly terrain you might want to do a few things differently in an emergency. The object is the same: to arrive safely; but we may have to go about it in different ways. Mainly, you want to survive the landing, avoid capture in the process and save the machine if possible.

Most pilots who have flown in the "green country" generally agree on several points. First get off a Mayday call. Chances are there's a helicopter nearby to execute a rescue in short order. Give your exact location over the emergency frequency and keep talking on the way down. The best possible result will be that you will roll to a stop to find him sitting on the ground waiting for you.

If there isn't a handy helicopter nearby and you're over a particularly hot area you may decide to ignore the wind, best fields and all, hightailing it toward the nearest friendly position. You can apologize later for pranging right beside the command post. That's a whole lot better than making a beautiful landing somewhere out in the sticks and spending the next day or two playing hide-and-seek with Uncle Ho's invaders. In the long run it's also probably a lot safer. Everything else being equal, a forced landing shouldn't vary too much from stateside flying. The big difference is that with a sky full of helicopters you might as well call one and get him to give you a ride home. The walk could be fatal.

So there you are. Go out and look at your airplane. You've fed her, cared for her, treated her at least as well as your girl friend. You know her joys, sorrows, strengths and weaknesses. But, like a spiteful child she may decide to quit. It may be today. Just keep asking yourself, "Where would I put it?"

crash sense
the following 28 pages prepared by the U. S. Army
Board for Aviation Accident Research



A SIP FROM THE FOUNTAIN OF KNOWLEDGE

Pierce Wiggin

SEATED AT THE BASE of the Tommy Trojan statue in the center of the University of Southern California campus, a bearded youth in T-shirt, frayed blue jeans and sandals strummed his guitar and sang to an admiring audience of students. He lost them in mid-chord.

"Hey, grab a look at that!"

All eyes turned to the tall figure marching along Childs Way. Wearing a gold lamé Nehru jacket, powder blue duck trousers, buckskin boots and carrying a cloth book sack over his shoulder, the object of their open mouth stares grinned under his handlebar mustache and puffed a cloud of smoke from his calabash pipe. Fierce eyes under jutting black brows stared back at them through pale blue lenses as he came to a halt.

"Could you chaps direct me to the registrar's office for graduate aerospace study?" He beamed a wide smile at the assemblage, fingering the Aztec calendar pendant that hung from a silver chain around his neck. "Ah, the academic atmosphere. Nothing like it to stimulate fruitful thoughts!"

Wordlessly, one youth raised his hand and pointed to the administration building. He continued to stare

as the tall figure executed an about face and marched into the building.

Major Horatio Frozzleforth, self-acknowledged world's greatest aviator, continued to turn heads and draw all eyes as he strode through the corridor, up the stairs, and into the offices of the Institute of Aerospace Safety and Management. He stopped, removed his pipe, and addressed a startled receptionist. "Good morning, fair damsel! I am MAJ Frozzleforth. Announce me to the dean, please."

"Are you here for the Army safety course, major?"

"That I am, young lady, that I am!"

"Then you'll want to see Mr. Andrew Reid, director of the Safety Division. I believe you're the senior officer and class leader for this course."

"Only natural, my dear. My leadership qualities are well known throughout the Army."

"Excuse me and I'll see if Mr. Reid is available." She rose and left the office, turning at the door for another long stare. The sound of suppressed giggles came from where she disappeared.

"Poor girl must have a cold," muttered Frozzleforth, walking to a window. He stared down at the throngs of students in the street below. His eyes were drawn to gaily colored sweaters and skirts. "Ah, the beauties of nature. I think I'm going to like it here."

"Mr. Reid will see you now, major. Follow me please."

Frozzleforth reluctantly drew his eyes from a blonde coed, turned, and followed the receptionist to another office. She opened the door and announced him. "MAJ Frozzleforth, Mr. Reid."

"Come in, major, and have a seat." Though he had been briefed on what to expect, the director's eyes mirrored astonishment as his hand was crushed in the grasp of the tall aviator. He waited until the receptionist left and closed the door. "We were expecting you yesterday, major. Your classes started this morning."

"Bless you, sir, but I don't require any special honors or entertainment. I slipped into town yesterday, found a suitable billet, and enjoyed a quiet evening at a discotheque. If I'd known you were planning a party for me, I'd certainly have been on hand."

"That's not exactly what I had in mind, major. Did you get the information packet from USABAAR?"

"Yes, indeed. Splendid chaps, those. I found the Los Angeles travel map most useful."

"Did you read the handbook and curriculum outline?"

. . . "I am Major Frozzleforth. Announce me to the dean, please."

"Unnecessary, Mr. Reid, completely unnecessary for a scholar with my academic background. I'm well versed in all the subjects we'll be covering. Only my great modesty keeps me from offering my services as a member of your faculty. However, if any of your instructors need help while I'm here, please feel free . . . "

"Excuse me, major, but I think it would be best for you to join your classmates. Students are supposed to be in uniform the first day, but I recommend you go as you are. This first session is very important and . . . "

The director's telephone rang as Frozzleforth stood.

"Reid here . . . What!? Hold on a moment." He covered the mouthpiece. "Major, are you driving a lavender convertible?"

"Yes indeed. An outstanding vehicle! Four barrel carburetor, 440 cc, racing cams, and . . ."

"Will you please double time out there and remove it from the dean's parking space? And, major, when you come back, don't bother coming here. The young lady who brought you here will direct you to your class. Good day, sir!"

"And a very pleasant day to you, Mr. Reid. Remember, if you need my talents at any . . . "

"Major, please! The dean is waiting!"

The director watched Frozzleforth leave, spoke into the telephone, breathed deeply, and collapsed into his chair. He stared upward and rapped his nuckles on the desk. "What have I done to deserve this? What?"

Frozzleforth adjusted to the college routine with great aplomb. As the days slipped by, he exerted his great leadership qualities over the students of his class, often insisting that one or more accompany him to the nearest bistro after the last class of the day where he would stand drinks and entertain them with accounts of his aerial exploits. He was firmly convinced they could learn far more from his first-hand experience than they could from what he termed "those theorists in the classroom."

"But, major," objected a young captain. "Everything I've heard in class seems factual and well documented."

"Bosh, captain! Pure bosh! If my vast experience has taught me anything, it's that superb flying skill is the greatest deterrent to accidents. All the knowledge in the world won't prevent an accident without it. I've demonstrated this many times. Why, only last year in Vietnam . . . "

"But, sir, all of us can't be the greatest."

"Exactly, my boy, exactly. That's why I'm so anxious to share my experience with you!"

Director Andrew Reid and three instructors sat

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"Exactly, my boy, exactly. That's why I'm so anxious to share my experience with you!"

Director Andrew Reid and three instructors sat

Dan Lewis recalled a similar case from the Air Force, Major C. R. Terror . . .

around a table in the faculty dining room. "Gentlemen, I asked you here to discuss a problem."

"Frozzleforth!" the three instructors responded in harmony.

"Harold, I suppose you've seen him most so far. Is there even the remotest chance he might scrape by in your class?"

"Not if his current grades are any indication. Physically, he comes to class. Mentally, I have no idea where his flights of fancy take him. Yesterday, I asked him to name three types of stresses and he gave me the names of three topless restaurants."

"Norman, how about you?"

"The same. He says he doesn't understand all the fuss and bother about accident investigations. According to him, any good pilot should be able to immediately identify what failed and caused the accident. He said he's done this many times and could have saved the Army a considerable amount of time and money if they had only listened to him."

Reid turned to the third instructor. "Dan, you haven't had a chance to observe him very much, but I remember you telling me about a similar case from the Air Force. Can you recall the circumstances?"

Dan Lewis, retired Air Force colonel, silver haired, with a clipped mustache and merry eyes, smiled. "Only too well! MAJ C. R. Terror came here from MATS in 1962. As I recall, it happened like this . . .

From the December 1962 *MATS FLYER:*

The days wore on slowly for C. R. as mathematical formulas, laws of physics, principles of structures, aviation physiology, accident prevention principles and regulations rumbled through his addlepated brain.

One day, while sitting in class daydreaming, Terror suddenly sat bolt upright in his seat. His eyes blinked as the pert brunette appeared in the doorway. "Monsieur Terror, would you come with me please?" she suspired.

Never one to refuse a lady, especially a beautiful French girl like Marie France, C. R. bounced from the room. He twisted his moustache and drew himself up to favor her with a full view of irresistable masculine charm.

"Ah, ma cherie," he began in his deepest tones, "My beautiful angel of mercy who rescued me from Giroux' electronic circuits in my hour of need . . ."

The poor girl's head began to swim at such masterful elocution. But, just in time, she remembered her mission.

"Mageour," she sighed, "Mr. Potter wants to see you — eemediately, he said."

George Potter, then director of Aviation Safety, was drawn up like a TAC Officer about to devour his first aviation cadet of the day.

"MAJ Terror, in all my years at USC I have never received any reports like these!" he thundered as he threw a sheaf of papers at the pear shaped torso.

"Des Gibson reports that you showed up at the aircraft accident investigation field problem with only a case of pre-mixed martinis instead of the recommended investigation kit. And then, as your report, you turned in one page on which you scrawled — quote — The pilot didn't eat any breakfast and couldn't hack the problem — unquote.

"Doctor Rickard reports that you inserted a *Playboy* center fold-out page in his anatomy wall charts.

"Doctor Martin reports that for the education speech on a subject related to flying, you rendered a report on 'The Migratory Habits of Airline Stewardesses Transiting The Los Angeles Airport.' He does admit, however, that you made excellent use of color slides as training aids.

"And as a class commander you far outdo your efforts in your own behalf. Dr. Kirk claims that in psychology you led the class in giving him the complete silent treatment for one solid week.

"Mr. Nielsen also reports that every night you lead the class to Hody's and not one person has ever attended a 'Dilbert' session. On top of that, you left one of his exams in only six hours and he has been locked in his office for three days, searching textbooks for new questions."

Mr. Potter paused and drew a breath for the final assault.

"MAJ Terror, the importance of your schooling here obviously escapes you. MATS' excellent aircraft accident prevention program is based on several factors — not the least of which is the quality of the accident prevention and investigation officers.

"To fulfill his purpose, the FSO must know not only how to put up safety posters and make out reports. He must know how to educate aircrews on safe practices. This requires first a knowledge of how and why people behave as they do, what affects both their physical and mental performance, what motivates them, and what can be done to guide them toward safer operation.

"Also the safety officer must have a knowledge of aeronautical engineering. To put it briefly, he must understand how the aircraft is put together so that he can find how and why it came apart. Then he can explain just why it must be operated according to the T.O.

"And lastly, he must be the paragon of knowledge, standardization and compliance. He must be respected for these qualities so he can lead, not usher, his contemporaries down the road to safety.

"MAJ Terror, do you think you measure up to these standards?"

The powerful engine throbbed and the tires bewailed their chastisement as the chartreuse Jaguar turned north off the San Bernadino Freeway. The pudgy little man turned to his svelte companion.

"You see, Yvette, the dean realized that executive capacity such as mine should not be expended on accident investigations. Old Uncle has lots of bright eyed young lads who can amply fill the bill."

"Now this 'Vegas is a real swinging town. Should be there by 2000 hours — just when the casinos get moving."

"One trick I did pick up from those people though. You just can't be too careful about anything. Open the bar and check the security and icing on the nectar of the gods, will you?"

Lewis drained his iced tea glass. "That's the story of MAJ Terror. He's still around, by the way. He appears regularly in the *MAC FLYER* and he's still up to his old tricks."

"Thanks, Dan. I suppose we'll . . ." He stopped as their waiter hurried to the table, followed by a security officer.

The officer addressed Reid. "Sorry to interrupt, Mr. Reid, but there's been an accident. A MAJ Frozzleforth from one of your classes ran off the freeway and wrapped his convertible around a pole."

"Is he badly hurt?"

"I don't think so. Doc said he'd be good as new after about three weeks in the hospital."

"What was he doing on the freeway at this time of day?"

"Said he'd been over to Hollywood for lunch and was hurrying to get back to class."

"Any idea how it happened?"

"The major said he was certain a tie rod end had failed. He said that was the only possible explanation for a man with his great driving skill leaving the road."

"Thank you, officer. Gentlemen, this meeting is adjourned."

AH-56A CHEYENNE

BREAKTHROUGH in MAINTAINABILITY

During design and development of the Cheyenne, maintainability has been considered equal in importance to performance, payload and weight

THE AH-56A CHEYENNE presently being built for the Army by the Lockheed-California Company promises far better performance and weapons effectiveness than ever before attained by any comparable system. Perhaps even more important is the "breakthrough in maintainability" that has been achieved through maintenance engineering efforts so that the Cheyenne can be maintained by Army crew-chiefs and technicians at organizational level, using existing Army tools and equipment, and with minimum impact on the Army's logistics system.

During design and development of the Cheyenne, maintainability has been considered equal in importance to performance, payload and weight. Every aspect of the configuration reflects this careful consideration of maintenance requirements and available maintenance resources.

Since the initiation of the Advanced Aerial Fire Support System (AAFSS) program by the Army, maintainability has been a primary consideration. This is attested to by the fact that the development contract includes some very stringent maintainability requirements. Most important of these requirements are:

- Not more than 3.9 maintenance manhours shall be required for each flight hour for all echelons of maintenance — as measured under closely controlled conditions.
- Operational availability shall be at least 85 percent, exclusive of parts or administrative downtime.
- Engine change shall not require more than 30 minutes.
- Turnaround, including fueling and arming shall not require more than 10 minutes.

These are tough requirements! To satisfy them, Lockheed has had a top flight team of maintainability engineers working directly with designers since the start of preliminary design on a day-by-day, drawing-by-drawing basis. Every installation drawing has had maintainability approval.

The maintainability engineers established design ground rules based on the contractual requirements and constantly reviewed all aspects of the design for conformance with these criteria. Some of the more important guidelines were:

- The Cheyenne must be completely self-sufficient for operation in the Army's forward austere environment.
- Organizational maintenance shall require no tools other than those included in the standard Army Mechanics Tool Kit.
- Special support equipment shall be avoided by designing-out requirements for such equipment and by deliberately designing the Cheyenne to use existing Army equipment.
- Components shall be designed so that no maintenance or servicing is required except at a 300-hour periodic inspection interval. Minimum time between overhaul for components shall be 1,200 hours and minimum component life shall be 3,600 hours — three times that of present day equipment.

Similar requirements for maintainability were included in specifications for all suppliers, and supplier performance is under close surveillance.

Specifications and requirements and analysis do not necessarily create a maintainable machine. But in the case of the Cheyenne the proof is in the actual hardware now undergoing test at Lockheed's Van Nuys, Rye Canyon and Oxnard facilities.

The degree to which the maintainability engineers have been effective is evident in the following system-by-system descriptions and illustrations of the features and characteristics that drastically reduce the maintenance requirements of the Cheyenne. It is these features — and many more — that enable Lockheed to guarantee the Army that the contractual maintainability requirements will be met.

GROUND HANDLING

Ground handling of the aircraft is conventional and requires only standard support equipment already in the Army inventory.

Towing is normally from the rear wheel using a standard tow bar, but lugs on each main gear strut permit forward towing using tow cable or rope.

Jack points are built into the wing (left and right) and the fuselage nose section. With standard jacks installed at these points, the entire aircraft can be jacked for leveling or for landing gear maintenance. A built-in jack pad is provided at each wheel to permit wheel, tire, and brake maintenance. A leveling plate and plumb bob attachment point built into the fuselage at Station 455 permit leveling in all axis.

Towing lugs can also be used as mooring points. Tiedown rings can also be installed at the wing and fuselage jack points. The standard Army mooring kit can be used for tiedown.

Built-in provisions for a screw jack device permit easy blade folding by a mechanic using a "speed handle" from the standard Army Mechanics Tool Kit. With one blade folded forward and one blade folded aft the Cheyenne can be hangared or parked in minimum space.

The reversible thrust propeller provides unique taxiing capability.

SERVICING

Fuel, oil and hydraulic systems are all replenished from the right side, leaving the left side completely free for rearming and other maintenance activity. Fueling can be by gravity or by pressure, and a connection to the aircraft fuel system is provided so that

the Cheyenne must be completely self-sufficient for operation in the Army's forward austere environment

the aircraft's own fuel pump can be used to draw fuel from a 55-gallon drum, a bag tank, or other source. All fueling can be accomplished by a mechanic standing on the ground.

An indicator is located adjacent to the servicing points so that fuel quantity is always visible to the servicing crew.

The engine, main transmission and propeller gearboxes all use the same type of oil. Each reservoir is equipped with an oil level sight gage, a chip detector, and a separate fillerwell.

A built-in pump and filter unit permits replenishment of hydraulic oil directly from standard quart cans. This procedure eliminates the contamination associated with use of funnels, fillerwells, etc.

On the entire aircraft only two fittings require periodic greasing. These are at the two drive shaft hanger bearings and they must be greased only at the 300-hour periodic inspection interval.

ACCESSIBILITY

Accessibility is almost synonymous with maintainability and the Cheyenne provides outstanding access to all service centers and compartments. Approximately 60 percent of the exterior surface of the fuselage is devoted to access doors and panels. All doors are hinged, have hold-open devices, and are secured by quick-operating latches or fasteners.

Separate compartments or service centers are provided for electrical equipment, avionic equipment, engine accessories, engine, swashplate, gun debris and fire control avionics, forward ammunition drum, aft ammunition drum, control servos, and communications equipment. Components common to each system are grouped within the appropriate service center to permit easier troubleshooting and maintenance. Service centers are painted white inside and are lighted.

In addition to access doors for major compartments, 78 removable panels provide access to various components, cables, connectors, pulleys, turnbuckles, etc.

The sponsons on each side of the fuselage can be used as work platforms with space enough for several mechanics and their toolboxes. The sponsons provide ideal access to the upper service centers, to the engine and transmission, and for inspection of the main rotor hub, blades and gyro.

A built-in ladder is provided at the aft end of each sponson. The left ladder is manually operated from the ground; while the right ladder is operated by an electromechanical actuator which operates in conjunction with the landing gear. If the gear is up, the ladder is retracted and if the gear is down, the ladder is extended .

A built-in platform along the right side of the forward fuselage is used for entrance to the cockpit. It also serves as a work platform for maintenance in and around the cockpit area.

STRUCTURE

Structure is semimonocoque. Skin, stringers, bulkhead rings and ribs are made of common alloys. Most repairs can be completed in the field using available materials and skills.

Major structural assemblies are designed to be replaceable. The aft fuselage section is attached by a series of bolts through a bulkhead ring and quick disconnects on cables and fluid lines allow rapid removal of the aft section for repair, replacement, or if necessary, to facilitate crash retrieval.

Wings are replaceable assemblies. Wing structure is simple because there are no ailerons, flaps or other movable surfaces.

Each of the empennage surfaces is attached by four bolts so that it can be replaced easily in event of damage.

LANDING GEAR

The main landing gear is of conventional design, retracting aft into the sponson on either side. The tail wheel retracts vertically until it is faired into the contour of the vertical fin. Struts are conventional air-oil type. All joints rotate on self-lubricated bearings that require no grease fittings. However, a grease fitting is installed at each wheel bearing so the bearing can be completely flushed with grease after operation in extremely dusty areas.

Main struts, drag struts, and most other main gear components are designed to be interchangeable left to right to minimize logistics requirements. The 39 X 11-10 tires permit operation from uprepared soft ground having a CBR of 2-½.

POWERPLANT

The T-64 engine is completely exposed for maintenance when the cowl is rolled aft. The cowl is secured in place with two interconnected latches. One mechanic, working from either side, can unlatch and slide back the cowl.

Uniball mounts, fluid and electrical quick disconnects, a slip-fit firewall and other design features permit engine replacement in 30 minutes. A portable hoist installed in suitably located structural hard points can be used for handling the engine, as well as main rotor blades, hub and transmission.

A specially designed bank of Donaldson filters will remove 85 percent of all dust and dirt particles over 40 microns in size from engine inlet air. This bank of filters will drastically reduce guide vane and compressor blade erosion and other engine damage caused by sand and dirt encountered when operating from austere forward areas.

AUXILIARY POWER UNIT

A built-in auxiliary power unit drives the complete accessory section of the main transmission upon which are mounted the aircraft's two 20 kva alternators, one of the two hydraulic power packages and the transmission oil pump. Thus, when the APU is operating, electrical and hydraulic power are available for troubleshooting and checkout of the electrical, avionics, hydraulic and flight control systems.

Through the hydraulic system, the APU provides power for engine starting. The APU also drives the transmission oil pump so that the transmission is preoiled prior to every startup.

The APU is installed adjacent to the left wheel well and is serviced and inspected through the wheel well opening. An access opening provided in the sponson skin above the APU permits use of a hoist. cable for lowering or raising the APU for maintenance or replacement.

MAIN TRANSMISSION

Many features have been designed into the main transmission to make it more reliable and to make both scheduled and unscheduled maintenance easier. All input and output shaft seals are designed so that replacement can be made on the flight line with no special tools. Inexpensive replaceable wear rings are used in conjunction with lip seals. Parker seals and "O" rings are used so the need for gaskets is obviated. Oil passages are designed for easy cleaning. A chip detector is installed as a warning device. The accessory section and forward part of the transmission are accessible through the accessory compartment. With skin panels removed, the complete transmission and its four attachment bolts are fully exposed.

ROTORS

The Lockheed rigid rotor is inherently simple. There are no flapping hinges, no lead-lag hinges, no dampers and NO GREASE FITTINGS. Each of the four blades is attached to a moveable hub section by two bolts. One of these bolts is a special expansion type that can be removed easily for blade folding. The movable hub is attached to an arm of the fixed hub by two fully exposed, self-lubricated, replaceable hinge-type feathering bearings and a tension-torsion pack that is also replaceable.

Blades are prebalanced and tracked. A vernier adjustment device in the pitch link permits accurate indexing so that blades can be interchanged without retracking.

Cyclic and collective control rods are located inside the 12-inch diameter main mast where they operate in an oil mist environment; where they are not vulnerable to battle damage; and where they cannot be used as handholds by mechanics.

The tail rotor is a conventional four-blade articulated system. Blades are interchangeable and, as in the main rotor, there are no grease fittings. Feathering bearings are oil-lubricated with a reservoir and sight gage for each blade.

All operating components are designed for at least 1,200 hours between overhaul and the blades, hub, gyro, etc., are all designed for at least 3,600 hours of fatigue life.

PROPELLER

The Hamilton Standard thrust propeller has been substantially simplified and employs a modular design approach which dramatically reduces maintenance times. The blades and actuator can be replaced separately. Replacement can be made on the flight line by mechanics with ordinary skills using only the tools found in the standard Army Mechanics Tool Kit.

Propeller blades incorporate a quick disconnect feature that permits a blade to be replaced in five minutes with no loss of oil. Only a standard $\frac{5}{16}$-inch wrench is required.

The blade has a steel core with a foam-filled fiberglass shell that can be easily repaired without removing the blade from the aircraft and without rebalancing.

The propeller actuator module is a sealed, self-contained package containing an oil supply, hydraulic pumps and distributor valve. It can be completely replaced in 10 minutes without loss of oil, with no special tools, and no subsequent adjustments are required.

The complete propeller and gearbox are mounted to the aft section by four bolts. Replacement can be made in one manhour.

Other maintenance features unique to the Cheyenne propeller include an oil-level sight gage visible from the ground, a gearbox port for viewing gear mesh, externally accessible oil pumps and a split, individually replaceable gearbox shaft seal.

The Cheyenne propeller has approximately one-third the number of parts of a conventional propeller, is considerably lighter, more reliable, and requires about 10 percent as much maintenance.

HYDRAULIC SYSTEM

Two completely separate hydraulic systems are used for redundancy and safety. The heart of each system is a hydraulic power package that includes pump, pressure regulator, reservoir, quantity gage and filter in a single package. The power packages are clamp-mounted to the accessory drive pads for

easy replacement.

A specially designed filler device, previously described, prevents contaminants from entering the system and thus eliminates the cause of most hydraulic system maintenance problems.

A ground hydraulic power unit is not necessary since the built-in APU drives one of the aircraft hydraulic power packages to develop pressure for system checkout.

FLIGHT CONTROLS

Only conventional helicopter controls plus a propeller pitch control (beta) are necessary. No rudder, elevator or ailerons are required. The primary element for control of the Lockheed rigid rotor system is the control gyro which requires no maintenance whatever. Although no stability augmentation system (SAS) is required for normal flight it is provided for the yaw axis to insure gunfiring accuracy. Maintenance problems associated with this system are minimal.

Collective and cyclic servos are mounted as a package below the swashplate, accessible through a large door in the fuselage lower skin. Servos can be replaced individually or the three servos can be replaced as a complete package. Hoisting provisions are built-in to facilitate replacement of the complete package.

The yaw servo for tail rotor control is mounted on the forward face of the horizontal stabilizer beam. With the leading edge of the stability removed, the servo is completely exposed.

AVIONICS

The Cheyenne has a number of communications systems and has remarkable navigation capabilities. Historically, maintenance of avionic equipment of this nature has consumed a high percentage of total maintenance time. Furthermore, identification of the faulty unit (troubleshooting) has been the avionic maintenance task requiring the most skill and the most manhours.

Achievement of a low overall maintenance-man-hour-per-flight-hour ratio for the Cheyenne necessitated a unique approach that would drastically reduce maintenance and troubleshooting requirements for the avionic systems. This improvement has been achieved by designing the avionic equipment to meet the following criteria:

- To the extent feasible, equipment is micromodularized so that it is smaller, lighter, and far more reliable.
- It is possible to isolate immediately any failure to a line replaceable unit (LRU).

A status panel in the cockpit indicates whether or not a system is operating properly. If a system is not operating properly, it is then necessary to identify the faulty line replaceable unit. For some components a failure is obvious or visible. For most components, however, a BITE (built-in test equipment) module within the component provides an automatic go no-go indication of the component's ability to function properly. The BITE module first checks itself and then checks the component. If the component fails to operate properly a white dot or pattern appears on the BITE indicator. The failure indication remains even after power is removed from the aircraft so the mechanic need not start the engine or apply electrical power to immediately identify the failed unit.

Avionic installations are designed to facilitate replacement of LRU's and with the auxiliary power unit furnishing electrical power, the replacement component checks itself out through the BITE module.

Many of the LRU's also incorporate a BITE indicator for each module within the unit so that a failure can be isolated to a plug-in card. For example, the central computer complex consists of five LRU's, each with a BITE indicator. The central processor unit, one of the LRU's, includes 28 BITE indicators, one for each module inside the unit. The module BITE indicators are visible from outside the unit so that even before the unit is opened the technician knows which module has failed.

Fire control and armament systems are still classified, but the same degree of attention has been given these systems to make sure that they can be properly maintained even under the most difficult operating conditions.

As an integral part of the Cheyenne maintainability program, Lockheed is conducting the comprehensive and rigorous maintenance analysis required by the Army's Maintenance Engineering Analysis Data System (MEADS). This analysis, the first conducted under Army contract, identifies maintenance tasks, task times and all the resources required to complete the task such as personnel, spares and repair parts, ground support equipment, data and facilities.

MEADS data also facilitate prediction and tracking of manhour requirements, availability, and other maintainability parameters. This rigorous analysis, coupled with iterative corrective design action and, finally, by 2,000 hours of flying simulated missions, will fully demonstrate the Cheyenne's "breakthrough in maintainability."

FOR THE CHEYENNE

PROFESSIONAL ATTITUDES in Army aviation, from those of Private Jones to those of the highest commander, have slowly but surely changed. We have finally arrived at a very old conclusion: It takes good maintenance to have good aircraft availability. However, it is obvious to even the most casual observer that the Cheyenne, a marvel of integrated systems, is an extremely complicated aircraft. For this aircraft to become truly integrated into today's Army and fulfill the Army aviation requirements of tomorrow, maintenance procedures and training of all support personnel *must be updated.*

A BETTER CONCEPT IN MAINTENANCE

LTC Howard J. Tuggey
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Unfortunately, compromises involved in making changes, obtaining adequate funding, training, personnel and manpower will continue to stop some of our plans just short of fruition. These obviously work to the detriment of the Army and the morale of the soldier in the field. Nevertheless, changes are needed.

One proposed change is the adaptation of the *specialized crew method of aircraft maintenance.* It is not new. In fact it has become a way of life in commercial operations, as well as in our sister services. This method is not to be confused with the *dock* method wherein the *dock* is equipped with stands and tools that remain static while crews move from one aircraft to another at specified intervals. Specialized crews are organized to perform complete maintenance on a particular type of aircraft where different types are supported — a specialized crew for a particular section of one or two types of aircraft who move to the aircraft and complete work on their particular section. This method is extremely flexible, promotes effective high quality maintenance, and has significant applications for our mission. These include:

1. Properly equipped crews working where aircraft are parked.
2. Ability to meet variations in maintenance scheduling.
3. Improvement of training concepts for more effective use of personnel.

Let's look at the advantages of such a system —

Specialized crews are completely familiar with the maintenance required in their area of specialization and know the exact tools and parts they will need. Aircraft can be efficiently and effectively repaired on site.

Normal operations will not be affected, since aircraft movement in and out of maintenance areas will only occur when major maintenance is required. Specialized crews will complete their work rapidly and return to their normal tasks of extended maintenance.

New personnel will be effectively trained. We've known or should have known that quality performance is the result of proper training and continued practice. Yet we continue to operate with crewchiefs who are expected to know each technical detail of their aircraft and with repairmen who are expected to accomplish a number of different tasks in a routine day.

The crafts system is as old as America and the advantages of establishing such a system in Vietnam and other overseas areas are manifold. Most of our current doctrine promotes such a system on a much larger scale. The concept of organizational, direct support, and general support maintenance alludes to this system. Unfortunately, skill levels of personnel are not necessarily reflected by the level of maintenance.

Since the normal tour of duty in RVN is one year, it is to our advantage to develop a man as early as possible and insure that he gives us quality and the inherent safety it promotes, as well as quantity. When our new PFC arrives, we put him on a specialist team, working under a master craftsman who may have months to go. He also learn from a journeyman who has months left, and from his normal overall supervisor who insures that maintenance management aspects are fully covered. The specialist on our imaginary team works only on the UH-1D from station 74 to station 241, or from the battery compartment to the tail rotor. In this way, our apprentice becomes acquainted with his specialty in a hurry and, depending on his ability, may be ready to teach someone else within months or less.

Meanwhile, Joe, who gets his work hit or miss on the *job assignment method,* will install a tail rotor today, main blade seal tomorrow, fiddle with the servos the next day, and spend half his time (we hope) reading his -20 and running back and forth to the toolroom and to his supervisor, getting the right tools and advice. If he does all of these things — and thank God many of our young men do — we will get the job done eventually and, normally, satisfactorily.

Specialization can eliminate many of the mistakes that man makes, and our more complicated aircraft dictate specialization as a *must* for the elimination of amateurish procedures within our present maintenance concept.

AR 1-24 states that management is dependent upon an exchange of information and understanding. We all must understand that the Cheyenne is an exotic end item, requiring support in maintenance and in

other areas that are as forward looking as the aircraft. For example, the 90° gearbox and pusher propeller, combined with a weapons system par excellence, and complicated electronics and armament systems, indicate both an advance in the state of the art and a requirement for concern when compared to some of our current assets. A $2 million aircraft will crash just as readily as a $50,000 aircraft from a quarter's worth of contaminated fuel, improperly torqued nuts or other unprofessional maintenance practices. Trade-offs and compromises must be stopped. Both our new and older aircraft need the tender loving care they deserve.

What can we do about it? For a starter, in the case of the Cheyenne, let's get everyone into the act before Cheyenne units are activated and deployed. Let's have appropriate personnel, authorized spaces, maintenance tools and concepts, and a support philosophy that will give the Army, its men, and the manufacturer, every chance to make the machine meet the challenge of today's rapidly advancing technology.

Why all the fuss? Well, we know that our major factor in retaining qualified personnel is motivation. Our aircraft mechanic or crewchief normally loves his work, but after his short tour in Vietnam or Korea, he returns home to find that a civilian contractor does the job and he is literally out of work. He is faced with a big decision that requires him to get out of the Army or find a new trade if he expects to advance. He may realize that returning to Vietnam is a way to continue in his job, but returning to Vietnam for continuous duty is not his desire.

The man out of service school has the same problem, but it is aggravated by the fact that he cannot apply his newly learned skill. Therefore, we begin all over again when he does show up at Danang or Saigon, rusty and out of practice. When he gets there, his time is limited and we need to extract productive high quality performance as soon as possible.

I have suggested that we establish a specialized maintenance system. This should be done at organizational and all other levels. TOE 1-57G, June 1966, is a good example: The airlift sections and aircraft maintenance sections have the necessary personnel to crew the aircraft, perform organizational maintenance tasks and assist the crewchiefs during intermediate and periodic inspections. If we take the UH-1D and divide it into four major sections, we can see the advantages of specialization. For explanation, let's call the pilot's compartment back to the transmission bulkhead, section 1; from the main rotor down to the swashplate, section 2; from the main transmission down to the hellhole and short shaft, section 3; and from the battery compartment to the 90° gearbox and tail rotor, section 4. The engine is a special section in itself. By assigning three men from the maintenance section as engine specialists, we have a total of 30 men remaining to accomplish the tasks involved.

If we establish two specialized teams per section, we will have a requirement for eight specialists' teams, totaling 24 men, with an additional six men to fill the teams and allow for leave, hospital and other unforeseen requirements. These specialists could learn their jobs well, accomplish their tasks in a highly efficient manner, and insure that the quality of maintenance reaches the highest possible level with inherent safety implications.

The crewchief then becomes an element in quality control and can devote more time to thoroughly reading his -20, inspecting his aircraft and detecting faults. With both he and his assistant learning weapons, they become more effective and valuable crewmembers for all missions. This system is compatible with the present MOS system and can be adopted at any level. When the specialist finds time, he can be cross-trained by his supervisor into other skills and expand his total knowledge.

Current aircraft distribution, with the majority of UH-1's, CH-47's, and CH-54's in RVN, the CH-21's in Korea, and the CH-34's in Europe, combined with short tours in all these areas, lends itself to specialization. Professional aviators and supporting technical experts must get behind such a system and let experience guide the new maintenance officer or commander to insure that his *adaptations* do not compromise the success of proven methods.

The Cheyenne has become a convenient vehicle for this dissertation, but its complex systems and our need to update the methods of maintaining such a machine require comment. The modular concept is fine but somewhere, somehow, we must get the mechanic, petroleum and other specialists into the picture. They must be given an opportunity to function in a less confusing system than we presently use. Where we start is immaterial, but we need to draw the full circle and we need to do it now.

CREDIT CARD NEEDED

OV-1 PILOT: " . . . I'm about to have an emergency . . . We don't know where we are now . . . Low fuel; in emergency. I'm low on fuel . . . emergency . . . Three thousand. My available flight is five minutes . . . Do you read?"

Witness: "I was in front of my home about 1330 when I heard the noise of a plane. It was flying very low at a moderate velocity. Under the plane, toward the tail, there was a red light blinking on and off. The landing gear was down and both motors were running. The plane made a turn to the left and then made another left turn with the left wing down. At this point, I heard two 'shots' close together and the first pilot ejected with a closed parachute. Then the plane, in a horizontal position, headed toward the river. I heard two more shots and the second pilot ejected, also with a closed parachute. Then the plane rose quickly and crashed . . . I went to the scene of the accident and saw one black chair about 20 meters from the pilot. The body was near a shallow ditch. The pilot still wore his parachute . . . "

Witness: "I was in my house and had just finished eating when I heard a loud noise of a plane flying very low. I immediately ran out of the house and saw a plane coming. It passed at a very low altitude above the woods just before my house. As soon as it passed, it turned left. The wings were level, except when it turned. The noise seemed normal, very loud. The plane, coming back in the direction from which it originally came, passed over the barn. Then, before it got to my house, it made another turn to the left, almost touching the trees, and headed toward the river. Before the plane arrived at the river, I heard two noises like shots while the plane was turning, and I saw two objects which looked like boxes leaving the plane, one on one side and the other on the other side. Then the plane turned again to the left, coming in the direction of my barn, rose up in the air, and hit the ground. I went to the wrecked plane and saw smoke and fire. There was no explosion."

The accident: The mission was to pick up an OV-1B. On the day before the flight, one of the pilots spent two hours planning the flight. The expected time en route was 3 hours and 10 minutes, with available fuel for four hours. Scheduled time for departure was 0900.

At 0830 on the morning of the flight, the pilots met at operations. It was assumed that the one who had prepared the flight plan would be the pilot. He had also obtained weather information and made all other preparations. *He declined the offer of a fuel credit card, stating that they had plenty of fuel and would not need it.* At some time between 0830 and 0900, the other pilot decided to assume the duties of pilot. Both then went to the aircraft and performed a preflight.

Engines were started at 0855 and takeoff made at 0910 on an IFR flight plan. At 1002, the flight was rerouted; at 1245, the IFR plan was canceled; at 1304, the pilot reported low fuel and declared an emergency; at 1312, he requested GCA pickup; and at 1325 he advised that he had approximately five minutes of fuel remaining. Soon afterward, radar contact was lost and no further transmission was received. The airplane crashed in mountains south of the intended flight route. The landing gear was found extended and the flaps set at 15 degrees.

Analysis: Weather was not considered a factor. The only restriction during the entire flight was visibility of 1.9 miles and haze at the intended destination. Ground witnesses confirmed that the weather in the area of the crash was good. The sun was shining, there were no clouds and the visibility was good. Accident investigators were concerned specifically with why the aircraft was south of its intended flight path, what the pilot's intentions were and what caused them to eject when they did.

Both pilots were highly qualified senior aviators. No evidence of mechanical difficulties was found.

Pertinent facts uncovered by the accident investigation board:

1. The pilot did not select an alternate, as required by paragraph 21a, AR 95-2, if forecast weather conditions are less than 5,000 feet and 5 miles. The forecast entered on his flight plan showed 3 miles visibility. Had he filed an alternate, an intermediate fuel stop would have been required. In addition, one leg of the flight plan was filed for southbound flight on a one-way northbound airway.

2. The flight was rerouted and the diversion added more than one hour of flying time to the prepared flight plan of three hours and 10 minutes, causing the fuel requirement to exceed available fuel endurance. No plans were made to refuel after the flight was rerouted. The reason for this is unknown. One possibility is that the charts used for the latter portion of the flight were of smaller scale than those used for the earlier portion and the pilots may not have realized the actual distance.

3. The pilots had a near miss with two jet aircraft at 12,000 feet and approximately four minutes later became disoriented. The board believed they became confused and tuned in the wrong beacon.

4. Evidence indicated the pilots then flew low, looking for a place to land. They ran out of fuel after four hours and 18 minutes of flight and ejected too late. The seats functioned properly, but they hit the ground before the main chutes could be deployed.

Cause: INADEQUATE PREFLIGHT AND IN-FLIGHT PLANNING, RESULTING IN FUEL EXHAUSTION.

Flight surgeon: ". . . The two aviators involved in this accident were temperamentally quite different. Both were well-experienced pilots. One was aggressive, strong-willed, apparently outgoing and approachable, and somewhat mercurial in temperament. The other was more deliberate, thoughtful, quiet, and somewhat introspective. Both aviators were in excellent health and physical condition. One had worked on the flight plan for approximately two hours on the day before the flight, and it was routinely assumed that he would be the pilot. It is not known why he did not select an alternate, especially if he had any reason to suspect that the flight would be diverted. This omission appears to be significant in view of later events and it seems reasonable to assume that he could have been more circumspect . . .

"On the surface, this officer did not display any emotion, either chagrin or disappointment, at the fact that the other officer decided to act as pilot. However, it is not certain just what his actual feelings were. It would be normal procedure to discuss major features of such a flight beforehand, including selection of alternate landing sites, review of maps, flight plans, fuel load, etc . . .

"The pilot was seen carrying his oxygen mask on his way to the aircraft. The copilot was not observed to carry his. A valid assumption could be made that he did have one, since he was well aware of this requirement in OV-1 aircraft. After the crash, the pilot's oxygen mask was found. However, the copilot's mask was never found.

". . . When a major route diversion was made, it should have caused both men to reassess the situation. Preoccupation with personal affairs, resentment, overconfidence, or all three, or more, could have distracted attention from fuel checks, check points, etc. In the event that one or both of the crewmembers refrained from using oxygen, even for relatively short intervals, the above would be more accentuated by the insidious onset of hypoxia symptoms and impairment of judgment, without the individual realizing it. What may have subjectively appeared to have been a short interval without additional required oxygen at altitude may easily have been an extended period of time. Such possible variables have to be interposed in this analysis in order to attempt to determine logical and meaningful reasons for apparent unexpected behavioral patterns in two excellently trained, well motivated, experienced, and ordinarily resourceful aviators . . .

"An erroneous decision was made which resulted in the aircraft making a turn away from its proposed destination . . . One beacon apparently came in loud and clear through the valley and low terrain over which the aircraft was flying. The second beacon meanwhile, on almost the same frequency, was getting fainter as they flew to the southeast. Channelization of attention was present to the extent that it did not occur to the crewmembers that it might have been the wrong beacon. They may have believed, however, that they had traveled much farther than they actually had, and had then turned on a heading of 160 degrees to their planned destination.

"The aim of saving the aircraft apparently was paramount in the minds of the aviators. It would have been to a greater extent in the pilot's mind. Loss of the aircraft to him may well have meant a tremendous loss of prestige and more specifically and important to him, possible loss of his position. The aircraft was seen making a low pass over a road on which it was possible to land without major damage. This plan was abandoned when vehicles were seen on the road. Still at low altitude, the pilot circled twice, possibly seeking an acceptable landing site. The gear was lowered. The ejection seats functioned flawlessly, but ejection at 100 feet of altitude with the aircraft in a bank did not allow time and room for parachute deployment . . .

". . . The negative attitude of planning in such items as nonselection of alternates, declining the offer of a fuel credit card, and perhaps, failure to obtain a portion of the map must be mentioned. There may have been some subconscious rejection of participation in the flight in the first place, *or in eventually arriving at the destination.* Both were certainly familiar with all the terrain over which they flew. *In any event, meticulous attention to planning would have eliminated most of the problems encountered.*

"Periodic physiological training — use of compression chamber, complete familiarity with oxygen requirements and use of oxygen equipment, actual planned exposure to the effects of hypoxia, etc., such as is done initially in training — should be required at least annually and receive emphasis . . .

"Sound training in ejection techniques should stress the fact that, by and large, the time to eject is when it first occurs to you that maybe you should . . . Training can emphasize the good points of the ejection seat and continue to instill confidence in it. Physical limitations of ejection seats must be well known to pilots and other OV-1 crewmembers."

ONE OF THE CURIOUS curses of our culture is the conclusion that anyone interested in his own safety is far too frightened to play the game well or give the job its fullest measure and therefore should be sacked on the spot.

This is a sad but realistic truth relating to man's own appraisal of manhood.

When it comes to "being a man," the average proud male cannot satisfy himself with buckling his biceps, or even by looking at the handsome progeny his seed had begotten.

Some secret spark of pride also directs that, should the occasion demand, the man will also be willing to conduct himself like an utter boob, disregarding all precautions — expressed or implied — in the performance of almost anything that will prove he isn't a sissy.

We lost a lot of good men that way.

And some of the characters classed as sissies, because they have at least a small regard for their own skins, manage handsomely to survive, live to see another day, and in the process contribute magnificently to the total goal.

This seems to be today's unsatisfactorily unsafe story of safety education — be it flight safety, highway safety, or even something as relatively minimal as household safety.

Let's flashback a few years: Baseball was born in Hoboken, N. J., in 1846. It was born a barehanded game. The first teams played with the same hard-

Chaytor D. Mason

From the University of Southern California Aerospace Safety Alumni Review

rock ball used today. But the baseball glove hadn't been invented. Caught with bare hands, the ball broke hands and split thumbs. Not every catch was a lucky one.

And so it went along its maiming way for 25 years until, on one sunny day, Charlie White, first baseman for Boston and tired of sore hands, came onto the field wearing a thin, but nonetheless protective glove. He never got a chance to use it. He was laughed off the field with a chorus of catcalls: "If ya that scared of the ball, don't play." "Catch the ball; don't muff it."

Gloves were not worn on an American baseball diamond for another five years. And baseball went through the same time-trials in the evolution of a catcher's mask, a chest protector, and even today's hard hat.

Football, you will remember, fared no better in the development of "safety appliances." You may also recall that it has only been a few years ago when one of these bits of evidence for superior manliness was the cool defiance of a quarterback heaving his heavy helmet heavenward. Now there was a MAN who would lead the team to victory, the fans said.

No matter the game, the story has been essentially the same. You saw it in baseball, football, hockey, boxing — or that grimmest game of all — war.

Even in war the development of life-protecting headgear, garments, and even practices historically has been considered a vile form of cowardice — unmanly and unpatriotic!

Let's look at the record for a moment:

In the American Revolution, the soldiers of his Britannic Majesty, George III, wore brilliant red coats and white pants and marched in bold, shoulder-to-shoulder formations against the sharpshooting guerillas of the day.

The Redcoats never really got the idea.

And about 140 years later the French Poilus and British Tommy Atkins were again marching off to war wearing crimson hats of cloth. Without so much as a change of uniform, they moved from the sidewalk cafes in Paris to the front.

With little more ado, they faltered and fell before the machine guns of the Germans — who happened to have been wearing very hard hats at the time.

Resistance to hard hats and the protection they afford was not necessarily a soldier-of-the-line idea. Despite directives from superiors, local commanders resisted trading off the bravado of the bright and soft hat for the dull steel helmet. One British commander went so far as to declare that anyone in his command who wore a hard hat would be court martialed on the spot for "cowardice in the face of the enemy."

It was just another case of a man trying to prove that he — as well as those in his command — weren't sissies and could firmly establish their manliness just by flaunting safety.

There are other stories and other examples and you can supply your own variations to the theme.

But the essence of it all is simply this:

We can talk about safety as a hoped-for ideal. But we will not even go through the motions of doing things safely unless they do not disturb our own ideas of what is manly.

It also means that, unless we make some sweeping changes in our own thinking about safety and about its relationship — if any — to manliness and all the business of being a man, we will continue to have the same old disappointing safety statistics year after year — in the air, on the highway, even in the home.

In the field of aviation safety, we can expect that the accident rate for junior flying officers will continue high because there are "manly" young men who are trying to prove themselves. But the same rates may apply for those officers in their "dangerous forties" who are trying to reprove their manhood.

Probably we will arrive at no improvement at all, in the matter of safety until we reevaluate "manhood." First of all, this must be a personal reevaluation.

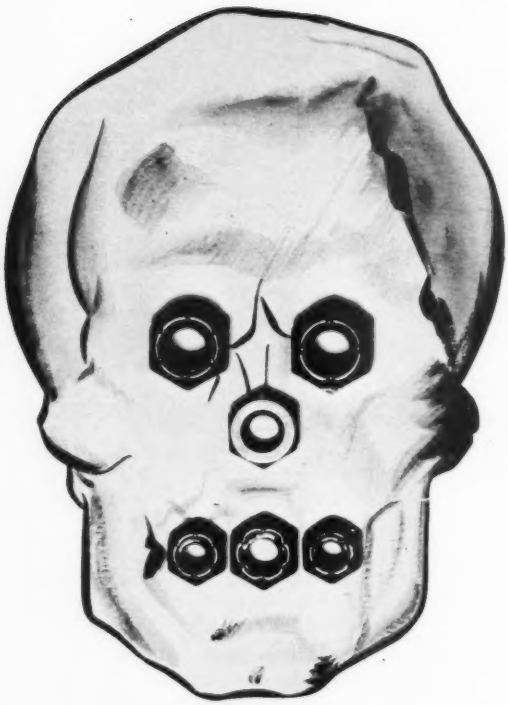
Is a MAN the one who runs headlong into a well-camouflaged machine gun nest knowing it means sudden death? Or is the real MAN the one who flanks the nest and throws in the destroying grenade?

Is a MAN the pilot who says, "give me a plane and point me toward the target . . . or the one who says, "a flak vest and a hard hat will help me on this mission"?

Is a MAN the one who scoffs: "I'll fly through this front or bust my butt" . . . or the pilot who is willing to set for a spell, wait for the ugly weather front to pass, and then gets up there to deliver the goods?

It's a strange heritage which decrees we are MEN only when we disregard caution . . .

It will take a lot of education.



SELF-LOCKING NUT REUSED

OH-23G PILOT: "I was flying at 1,500 feet and 70 knots when I noticed a loss of engine and rotor RPM. I added throttle and reduced collective pitch to a minimum to regain the lost RPM. As the RPM returned to normal, I reapplied collective and noticed that the collective pitch stick had become very easy to move and its application had no control of the main rotor. I continued in my power-on autorotation at 70 knots. I made numerous movements of the collective stick up and down, with no effect . . .

"I had full control of the cyclic system and maneuvered into a large rice field for landing. Approximately 15 feet from the rice field, I applied aft cyclic and flared to slow my rate of descent. The aircraft was landed in this attitude into about 2 feet of water in the rice field. I touched down with about 5-10 knots forward ground speed and the aircraft came to rest in an upright position. I shut the engine off and we got out."

Analysis: "The collective pitch system failed due to loss of the clevis bolt. Loss of RPM occurred because the rod end worked out of the bellcrank and lodged momentarily between the bellcrank and engine mount strut, forcing an increase in collective pitch. When the pilot lowered the collective, he caused the rod end to withdraw enough to free the bellcrank and the upper portion of the collective control system. Fortunately, the collective pitch went to the minimum pitch position, which caused the aircraft to enter autorotation. The pilot's technique for landing under these conditions must be considered outstanding . . .

"When the aircraft entered the water the tail rotor blades were sheared about 1 foot from the blade roots. The torque forces generated in the tail rotor system when the tail rotor blades struck the water

caused the tail boom to buckle and some rivets to pull loose. This torque also caused the 1-inch drive shaft to twist and break as the engine was still at operating RPM. One main rotor blade flexed down enough to crease the 1-inch drive shaft. The windshield on the left side of the cabin was broken due to the impact with the water or the bottom of the rice field.

"The missing clevis bolt has a slotted head which faces aft when installed. It is retained by an all-metal self-locking nut which faces forward and slightly to the right. The nut is difficult to see during visual inspection. This nut was probably reinstalled when the engine and transmission were changed. It is reasonable to assume that the nut was inspected for serviceability as stated by the mechanic who performed the work and then reused the nut."

Mechanic: "I was more or less in charge of the repair of that aircraft while it was in our shop. I completed the majority of the work and signed off most of the entries on the DA Form 2408-13. I cannot definitely remember if I installed the clevis bolt in the collective system. I most likely did install that bolt. If someone else did, I probably inspected the work. The bolt is installed with head to the aft and uses a metal self-locking nut. If I did install that bolt, I would not have used a torque wrench, but would have relied on my experience and feel to tighten the nut. To determine whether the old self-locking nut is serviceable or not, I run the nut down on the bolt as far as I can by hand. If the nut goes down on the bolt further than the top of the nut, it is considered worn out and needs replacing. I usually check all self-locking nuts in this manner. I have found many self-locking nuts that need replacing, but I have never found a nut on any flight control that was loose. I have never found this particular clevis bolt to be worn."

Crewchief: "I did pull the daily inspection on the aircraft the day before it went down. I checked over the complete aircraft, but do not remember checking the specific bolt in question. I cannot say for sure the bolt had a nut on it or not."

Analysis: "Neither the mechanic nor the maintenance supervisory personnel were aware of the caution note located on page 30, TM 55-405-2, which states: 'Self-locking nuts installed in critical applications will not be reused. Critical applications include flight and engine control systems; rotor, transmission, and engine mounting systems; or any single bolted structural joint (such as tie rods, strut wing attachments to fuselage, stabilizer surface attachments, longeron joints, and alighting gear joints) which serve as a primary load path. Self-locking nuts will be replaced only with new and unused self-locking nuts of an approved type.'

"The reason for this caution note is now apparent. At some time during the 9.4 hours the aircraft was flown, the self-locking nut worked loose and backed off completely. The crewchief who performed the daily inspection and inspected the push rod ends for end play probably saw the bolt in its proper position. However, he did not notice whether the nut was secured or not. The pilot committed the same error during his preflight.

"When the nut finally came off, the bolt worked free and fell out of the bellcrank. At this point, collective control was lost. It is possible that the bolt could have broken in flight and come out of the bellcrank. However, there were no scratches or other evidence on the surface where the bolt was installed to indicate this had happened."

IMPULSIVE AND WRONG

OH-13S PILOT: "I was on a local test flight, checking autorotation RPM. The area I picked was off the LZ, but I had landed there several times on previous test flights. I had checked the ground prior to autorotation to see if it was suitable for a touchdown in case I had to make one. I climbed to 700 indicated, approximately 650 absolute. As I entered autorotation, I closed the throttle too abruptly and the right skid dug into the sand and the aircraft overturned on the right side."

Investigating officer: "The primary unsafe act which made this accident inevitable was the test flight autorotative technique employed by the pilot. Some aviators think the best check of autorotative RPM is with the throttle fully closed. This is not the case, especially with a reciprocating engine. Autorotative RPM can be validly checked when the engine and rotor tachometer needles are positively split. With the throttle in the idle position, a safe power recovery can be made at any point during the test autorotation.

"Contributing was the pilot's attempt to check too many items at one time. He stated that the purpose of the flight was to check the collective pitch, autorotative RPM and throttle. Each should have been checked separately . . .

"The pilot did not use the safest area over which to check the throttle rigging, *especially since the engine had a history of quitting when the throttle was abruptly closed.*"

Flight surgeon: ". . . Questioning the pilot produced no evidence that any physiological, psychological or motivational factors could have been operative. On confrontation with the board's cause factors — poor planning and operational mistakes — the pilot was defensive and responded with no evidence that he recognized any such deficit. In my opinion, the pilot exhibited the impulsiveness, overconfidence, and lack of careful thought that would be both consistent with the board's determination of cause factors and defensiveness on questioning about these."

Supervision was added as a cause factor for this accident, based on the impression created that the pilot was using a procedure which had frequently been used previously, and the statement of the flight surgeon on the pilot's attitude. The necessity for instilling in all aviation personnel that lack of planning and haste are the causes of many unnecessary aircraft accidents cannot be overemphasized.

STRETCHED

UH-1 PILOT: ". . . I had to qualify in the H model. I had not flown this model before. We went out to the aircraft and performed a thorough preflight. The IP showed me a few different characteristics of the aircraft, things that could possibly go wrong and things to look for. We took our time running up and everything checked out.

"He had me pick it up to a hover and call the tower for clearance across the active runway to the autorotation area. We crossed the active and he showed me the layout of the area. Then he had me do a couple of hovering autorotations, after which we hovered over and did a couple of slope operations.

"I made a normal takeoff and flew a traffic pattern at 1,100 feet. Turning from base to final, the IP said he would take over and demonstrate something. He took it and went into autorotation, saying he was going to demonstrate how to stretch a glide. He put the aircraft into about a 95-knot attitude and, as we had about 95 knots airspeed, he pulled the rotor RPM down to 230.

"I checked it out on the tachometer and the needles were split. We had 72 percent on the gas producer. Everything seemed to be going all right until about 75 feet from the ground. I figured there was something wrong. We were doing absolutely nothing, except increasing our rate of descent. I'd say we had about 1,000 to 1,100 feet per minute rate of descent.

"It seemed to me that the IP had put it into a slight deceleration attitude and we decelerated slightly. We got no lift out of it or anything else. We just kept mushing right in. The rotor RPM never went above 230 after he pulled it down the first time. I was expecting him to pull a big flare down at the bottom to get the rotor RPM back or to make a power recovery, but he never did. I watched the instruments all the way to the ground. At about 50 feet, he put the aircraft into just a little more than skid level attitude. It had no effect. We slowed from 95 to 80 knots, and, when we hit the ground, we were going directly down the line of flight. We had 80 knots and there was 72 percent on the gas producer.

"The engine was still running and there were no warning lights or anything. I did not see the egt. We hit in a skid level attitude and bounced. I think the rotor RPM was 200 and decreasing when we

GLIDE DEMONSTRATION

hit. We hit very hard on the heels of the skids, bounced, yawed 90, and started to roll . . ."

Q: "You say that the first maneuver you were going to perform on your checkout was an autorotation?"

A: "That's correct."

Q: "And prior to him taking it over you were going to perform it? He wasn't going to demonstate one first until the last minute?"

A: "No. He took over when we turned on final and told me he wanted to demonstrate something. Up until that time, I thought I was going to do a normal autorotation."

Q: "From your experience in flight school, do you think when he chopped the throttle he was close enough to the field? Was he too far, too short, or what?"

A: "I don't know. From the extended glide that we had, we were off to the left rear of the field. We would have touched down maybe 100 yards off to the left rear of the field, if the deceleration had worked. But it didn't. The rotor RPM was just too low, I thought. That was the biggest factor."

Q: "Then you say that as soon as he chopped the collective he bled the rotor RPM off to 230 immediately?"

A: "He chopped the throttle, lowered the collective, and then bled it off to 230 RPM."

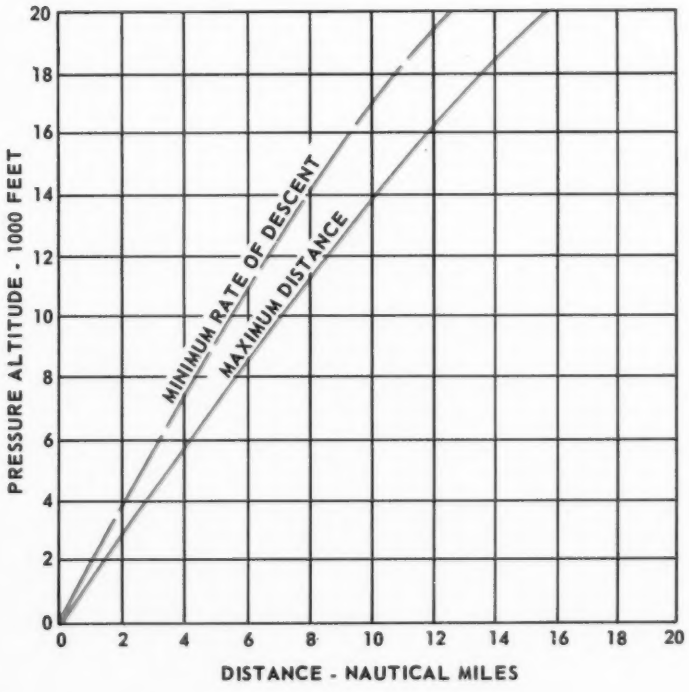
Q: "How did he do this?"

A: "He pulled in the collective."

Q: "You saw him pull pitch and bleed off the RPM to 230?"

A: "That's right."

Paragraph 4-10, chapter 4, section III, TM 55-1520-210-10, states: "A forward glide speed of 99 knots (roof mounted pitot) or 85 knots (nose mounted pitot) IAS will result in obtaining the maximum gliding distance." Figure 4-1 in the 40 shows that the rotor RPM must be 294. The aircraft involved in this accident was equipped with a nose mounted pitot.



UH-1D
MAXIMUM GLIDE DISTANCE, POWER OFF

AVERAGE G.W. = 7100 LB.
ROTOR RPM 294
REFERENCE: FTC-TDR 64-27

NOTE

(1.) Autorotational descent performance is a function of airspeed and essentially unaffected by density altitude and gross weight.
(2.) The speed for best glide distance is R-99, N-84 knots IAS.
(3.) The speed for minimum rate of descent is R-64, N-53 knots IAS.

R — Roof-mounted pitot tube
N — Nose-mounted pitot tube

PEARL'S

personal equipment
and rescue / survival lowdown

Writing in the August 1968 issue of the USARV AVIATION PAMPHLET, LT James R. Hipp gives his personal account of a vertigo induced accident and some excellent advice

VERTIGO

1LT James R. Hipp

IT WAS 0430 when the CQ shook me from a sound sleep. He shined a bright light in my face and said, "It's four-thirty, sir." I sure hated to crawl out of the rack . . . I stomped around in a daze, finally got all the morning necessities taken care of, ate breakfast and headed for my aircraft.

My pilot and I made a thorough preflight and left for our assigned mission. With us were seven other pilots who were going to fly with another unit that day. It was still dark, but I was familiar with the area and had no worries. We dropped the pilots off at their destination and headed for our C&C mission.

The sun was just beginning to come up and I knew that there was a long day ahead. When we arrived at the CR, the colonel wasted no time in getting airborne. We flew most of the day and finally he said, "Well, I guess that's it for today, gentlemen. You can head home." It was almost 1800 . . . I refueled to 1,000 pounds. I knew I still had to pick

up the seven pilots before returning home. If I topped it off, I'd never make it off the ground. We landed for the passengers and five were ready to go, but we couldn't locate the two remaining pilots. We later found they had already left.

Through the day, the weather had been good, on the cool side. No storms were threatening, except in the mountains. We had no idea that there was a storm to the south.

At 1915, everyone was back and we started getting ready for our flight home. It was 1930 when we finally pulled pitch and it was getting dark. We headed south and, after reaching 1,500 feet, we called for an artillery advisory. They advised us to stay along the coast. We then called our operations and gave them a position report. We were 25 minutes out and the weather was getting bad.

It was at this point when everything started happening. I called operations again and told them to have GCA standing by. "I think we are going to need it." I remember my pilot saying, "Jim, are you okay?" Then he said, "I've got it."

I said, "You've got it," and released my grip on the controls. We were IFR and the rain was beating on the windshield. I felt we were over the water and told my pilot to turn to a heading of 270° so we could get back over land. I started looking for land but could not see a thing. The altimeter read 800 feet.

"I see land. Let's drop down to 300 feet. We're over land. Turn to 180°. I've got it." I continued descending and again we were IFR. You can't see those clouds coming up at night. I know that my pilot was looking for land along with the five pilots in the back.

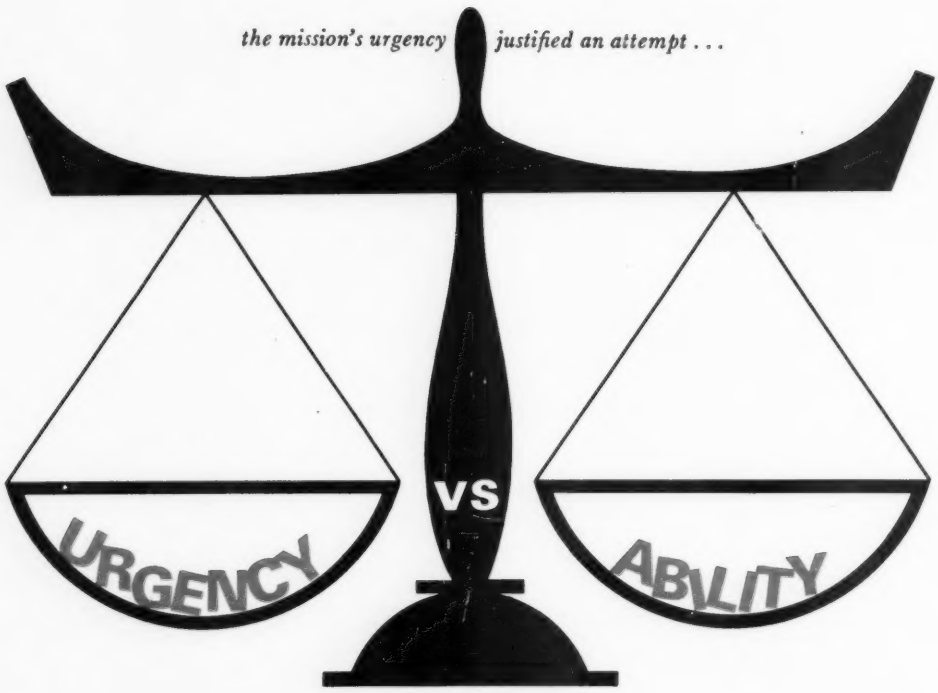
"Jim, you're in a left turn." The last thing I remember was rolling end over end and then sideways. My gunner had pulled the pilot out of the cargo compartment and they began looking for the other people. I was suspended by my seat belt. I pulled the release and fell into about 4 feet of water. Only four of us were able to walk and it was pitch dark. The four of us found the other five and got them up on a dike. Then a lightning bolt flashed and I saw a shelter. We got everyone over to it, but it was filled with mud and water from the heavy rain that was still falling.

After getting everyone as comfortable as possible, my pilot and I returned to the aircraft to see what we could salvage, since we had nothing but what was on our person. We found two first aid kits, a strobe light and a flashlight. On our way back to the shelter we stumbled on a carb 15. We at least had something besides .45 caliber pistols. The medical kits were used as best as possible and the long wait began . . . We hoped a search party would be out, but had our doubts due to the bad weather. Most of our time was used to help the injured and set up a small perimeter.

Suddenly we heard helicopters in the area, but saw nothing. Then flares began to fall all around our position and, for the first time, we could see the surrounding area and see how close to a village we were. We also stared at the wreckage. I don't understand how any of us made it. We began signaling, but to no avail. I felt our last chance for a night rescue had gone when that final flare burned out. Approximately 30 minutes later, flares again began to drop. Again, the flashlight and strobe were used for signaling. This time, a gunship spotted us and landed to give assistance. We put the two most seriously injured on board for medevac. The flares kept falling and one gunship kept circling over the area. About 15 minutes later, a slick and a dustoff arrived. Three more injured were put aboard the dustoff and those of us who could walk climbed aboard the slick. The pilot pulled pitch and our nightmare was over.

As a result of this accident, I now *wear* my survival kit while flying. After the crash, the only equipment we had was personally attached. All other gear was lost in the debris. If we could have found the RT-10 survival radio in the wreckage, I'm sure rescue would have been only minutes away, instead of 4 - 5 hours.

You can get vertigo, as both the pilot and I did. Once you experience vertigo, you will never forget it. I now know why they say in school, "Keep one man on the instruments." Believe me, it's a good idea. . . .



ACCIDENT: ". . . The crew was notified of an urgent evacuation mission. The pilot commented to the aircraft commander that weather had prevented other standby aircraft in the vicinity from reaching the pickup site. After gathering their equipment, the crewmen readied the UH-1H for departure and the aircraft commander checked in at communications to obtain the mission sheet and check the map location and route to the pickup site. Shortly afterward the pilot also checked the map for similar data.

"The aircraft was then started and navigation lights and rotating beacon were placed in the on position . . . Weather conditions estimated by the tower operator were approximately 1,000 feet overcast, with ragged and scattered clouds at 200 feet. Visibility was estimated at 2-3 miles in light rain . . . .

"Approximately 1½ minutes had elapsed from takeoff when a descent was begun and initial contact was made with tree branches and limbs 45 feet above the ground. Approximately 50 feet from this point, the plexiglas was shattered from the cockpit and the aircraft crashed . . . ."

The four crewmembers were killed and the helicopter was destroyed.

Witness: "Four months before the accident, I flew with the aircraft commander as an instrument instructor, to prepare him for a check ride for his standard instrument ticket. After reviewing his records, I found he had a significant number of hours, both hood and link. I was impressed with his desire to fly instruments and his knowledge of regulations and procedures. He was very thorough in his planning and preparation for the flights. When we flew, he had great difficulty in controlling the aircraft while planning for further clearances, frequency changes or giving radio reports. His touch control was erratic and rough. There was a tendency to get vertigo while flying straight and level. After several flights, it was my professional opinion that he would never reach the level of proficiency that would enable him to successfully complete an instrument check ride . . . ."

Witness: "I had known and worked with the aircraft commander for two years. He was a fine and very professional pilot in VFR weather, but he had a great deal of trouble whenever he flew under the hood. He would become erratic at the controls, unable to hold a heading and altitude. Realizing his shortcomings, he worked hard to improve himself. He went to the link trainer as often as he could and acquired a great deal more link time than anyone

else in our unit. If at all possible during a regular flight, he would fly instruments and he acquired many more hood hours than anyone else. He studied instrument procedures diligently and knew them very well. It was his aim to get his standard instrument ticket. With all his hood, link and instrument training, I could see little improvement in his control techniques under the hood during the times I flew with him."

Analysis: ". . . The crewmembers were well rested, in good physical condition and alert. They were known to be capable aviators and had a deep sense of urgency toward their medevac mission . . . The aircraft commander had compiled 52 hours of link training and 27 hours of hood in an attempt to acquire a standard instrument rating and overcome his known instrument flying deficiencies. Although considered an excellent contact pilot, he could not readily adapt to instrument flight. He was thorough, precise and very knowledgeable about procedures, but he could not properly divide his attention in the air . . . His total flying experience was 581 hours, of which 42 hours were night flying.

"The pilot was considered an excellent contact pilot by aviators who had flown with him. He had flown night missions with no apparent difficulty when references to visible horizons were not continuously available. No weather instrument flight time was recorded in his flight records however. His first pilot night flying experience consisted of 21 hours . . . . His total flight time was 369 hours. Both aviators were familiar with the terrain in the vicinity of the accident.

"The aircraft commander was seated in the left seat and the pilot in the right. It was not determined who was actually at the controls at any time during the flight, or how the duties of the cockpit were managed . . . .

"The left seat affords better outside visibility, but an inferior instrument display, particularly in the case of alternating current failure. The left seat has no control element for the search or landing light. An aircraft commander seated on the left can readily manage communications, navigation, and changing demands of the mission, as well as simultaneously monitoring his flight instruments. The pilot on the right side is then able to devote his entire attention to control of the aircraft by instruments and comply with the instructions of the aircraft commander. It is apparent that aircraft commanders flying on the left, however, should have some degree of instrument proficiency from that side and be aware of the problems encountered with alternating current failure.

"During hover, taxi and takeoff, the white landing and/or searchlight was used. This would have caused some loss of night vision for the 1½-minute duration of the flight. The takeoff departure was normal and no turns were necessary in the climb . . . .

"The aircraft began a descent and the popping of the rotor blades was heard for a few seconds by one witness. In tests to determine the condition under which the popping noise occurred, it was found that the popping occurred only when descent was started with power. Under conditions simulating engine failure, the popping sound was not heard. These results gave the only indication about whether or not the engine was operating at the time of the accident.

". . . whatever the cause for the descent, the crew could not or did not cope with the situation. Judging from the level, straight forward descent angle, the aircraft was apparently under control when it entered the trees. As the helicopter descended into the trees and the rotor blades began chopping limbs, a portion of one blade was torn away, probably causing extreme imbalance and dissymmetry of lift . . . The main rotor blades showed no sign of contact with any portion of the airframe nor any evidence of control failure or mulfunction prior to mast separation . . . .

"The board concluded that the mission's urgency justified an attempt, although its success was questionable. The mission conditions were challenging, but not uncommon or unique. The flight experience of each aviator was limited, particularly with respect to weather instrument flight, and one had a known instrument deficiency. . . both aviators could have been taxed beyond their capabilities. There was no room for error . . . ."

Flight surgeon: "An aircrew with limited instrument experience accepted a mission under marginal weather conditions. The mission had previously been attempted by three other aircraft which aborted due to weather and zero visibility. The pressure to accomplish the mission can be inferred as a significant factor. Shortly after leaving the departure point, the weather conditions worsened over the area. In an attempt to remain below the ceiling, perhaps because of lack of confidence in their instrument capability, they descended to an unsafe altitude with respect to the height of the jungle canopy. Upon contacting the treetops, an attempt to turn was made. Considering the assumed lack of visual reference in the area, there may well have been spatial disorientation on the part of the individual in control of the aircraft. Even if the other pilot was not disoriented there was insufficient time for him to take corrective action . . . ."

VIEWS FROM READERS

Sir:

In recognition of the emphasis placed on safety by the AVIATION DIGEST I would like to suggest to your readers ways in which safety officers may present their topics in a more palatable manner.

There seems to be an assumption by many safety officers that people don't *want* to think about staying alive and therefore it is their job to cram safety down resisting throats. Their favorite method of doing this is through coercion and the "mandatory" monthly safety meeting wherein names are taken and checked against personnel rosters.

In the early days of elementary education the counterpart of this type of forced learning was rote memory. The theory was, to teach someone something unpalatable you had them memorize, memorize, memorize. Understanding and awareness were expected to magically bubble forth as a result of this forced feeding. In our own day many safety officials use the same form of thinking by "making" us attend safety lectures whether they have anything to say or not. ("Hey, it's that time of month again. Now what can I cover this time . . . ?")

It follows that the time the meeting is held is normally inconvenient, the subject inadequate and often boring and we find ourselves watching an endless series of slides, hearing unnecessarily detailed accounts of the weather "over the past 20 years," and maybe we get five or 10 minutes of something that pertains to the subject at hand. The real problem comes when the safety officer suddenly realized he is through talking but his scheduled 50 minute "hour" hasn't elapsed. We then get the time-killing treatment and a general fuss (usually maintenance vs operations) concludes the stimulating experience.

There are good monthly safety meetings of course, such as you might expect from a well-trained volunteer group, but even the officers who run these meetings fail to see that perhaps their methods are a little behind the times.

There *is* a better way to present safety subjects.

Educational experts from the civilian community found long ago that small bits of information presented in a repetitive manner are absorbed much more quickly than are mass doses of the same subject matter.

Psychologists hired by the television networks also have verified the "simplicity-repetition" formula of learning and as a result we are deluged with constant reminders that Brand "X" is better for us. What does make the difference is the advertising that creates a difference in the consumer's mind. By the use of repetition they hammer their message into our subconscious mind and the result is ever-increasing sales.

Why can't we use the same subliminal psychology to make aviators conscious of many accident prevention measures? Isn't it at least worth a try?

Some suggested proposals would include:

- Skip the monthly dissertation, replacing it with short "commercials" in printed and verbal form.
- Expand the "five-minute safety talk" idea so any unit commander, operations officer or safety officer has a way at his fingertips to remind others of safety.
- Greater circulation of accident board proceedings (with proper deletions).
- The expansion of periodic safety "newsletters" to include copies for the desk jockeys.
- Increased availability and distribution of the ARMY AVIATION DIGEST. Old copies just don't serve the purpose well enough.
- Increased efforts to make safety a part of staff, command, and preflight gatherings. The Aviation School at Hunter, Ft Stewart, as one example, has one safety tip a day presented to each class in session. Maybe it is only one sentence, one picture, one simple thought but it usually sticks and students learn from it.

Let's save the large, mandatory type meeting for times when they are really needed. If we modernize our learning techniques we should be able to make more aviators safety conscious and thereby avoid the harassment of "What! Safety meeting . . . again?"

MAJ Gary Dennison
Flight Commander
Hunter AAF, Ga. 31409

★★★

Sir:

It is requested that the following information concerning the U. S. Army Armor School's nonresident instruction program be published in the DIGEST:

The U. S. Army Armor School, Fort Knox, Ky., recently published its 1968-1969 Armor Correspondence Course Catalog. The catalog, designed primarily for Reserve Component officers and enlisted men, outlines in detail the nonresident programs of instruction currently being administered by the Armor School.

The recently completed reorganization of the Reserve Components caused many officers, who were fully branch qualified, to be transferred to another branch because of the redesignation of their units. The nonresident instruction programs offer these individuals several methods by which they may qualify in branch Armor and educationally qualify themselves for promotion.

Enlisted personnel have the Armor NCO and Armor Senior NCO courses available to them; as well as MOS-related courses in MOSs 11E, 11D, 31C, 31G, 45G, 63B, 63C, and 63F.

For further information, write to the Chief, Nonresident Instruction Division, Instructional Services Department, U. S. Army Armor School, Fort Knox, Ky. 40121, or call AUTOVON 631-1460, extension 3253, or commercial to Area Code 502, 624-3253 during normal duty hours.

MAJ Robert M. Bissell
Chief, NRI
U.S. Army Armor School
Fort Knox, Ky. 40121

ICING

What Do The Forecaster's Definitions Mean?

AS WE ENTER the winter season the problem of aircraft icing becomes more of a concern to you as an aviator. However, an even greater problem frequently arises through a lack of understanding of the forecasted intensities. Too often the operational effects are not the same as those anticipated when the forecaster gave his report.

In 1964 the National Coordinating Committee for Aviation Meteorology established standard, definitive terms to designate the intensities. The terms are based on the operational effects on C-54 and C-118 aircraft under normal loading and cruise conditions.

Obviously neither of these aircraft are standard for the Army. However, this provides a positive basis for forecasting and knowing what that basis is should help all aviators.

According to Air Weather Service Manual 105-39 the intensities, physical characteristics and required action are:

• *Trace of Icing.* The presence of ice on the airframe is perceptible but the rate of accretion (accumulation) is nearly balanced by the rate of sublimation (evaporation). The use of de-icing/anti-icing equipment normally is unnecessary. It is not a hazard for aircraft without icing equipment unless encountered for an extended period of time.

• *Light Icing.* De-icing/anti-icing equipment will dispose of the accumulation and occasional use of such equipment may be necessary. If it is not used the rate of accretion is sufficient to create a hazard if flight is prolonged in this condition. However, it is ordinarily insufficient to make diversionary action necessary.

• *Moderate Icing.* Use of de-icing/anti-icing equipment is mandatory or immediate diversion is necessary. If icing equipment is not used the rate of accretion is excessive, making even short encounters under these conditions hazardous.

• *Heavy Icing.* Under these conditions de-icing/anti-icing equipment fails to reduce or control the hazard. Immediate diversion is necessary. The term "severe" may be used instead of "heavy" outside the United States. The characteristics and required corrective action are the same for either term.

Obviously, since these forecast terms are based on large, well-equipped cargo planes, the Army aviator flying a lighter, less sophisticated aircraft should adjust accordingly. Army regulations, for obvious reasons, prohibit flying in moderate to heavy conditions.

Merry Christmas to all...

may the new year bring you
the best in personal equipment
and rescue / survival gear
and the determination and
knowledge to use it for all
your flights